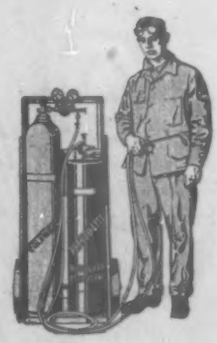
*Of this issue more than 4000 copies were printed*

# The Welding Engineer

Vol. II. Chicago 608 S. Dearborn St. FEBRUARY, 1917 $2.00 per year in U. S. $2.50 per year abroad No. 2


## Oxy-Acetylene Welding and Cutting

## Opens the way to greater profits in your shop or factory



In every shop and factory where welding is done, there are opportunities for greater profits by the use of the Prest-O-Lite Oxy-Acetylene Process.

You may be realizing a profit on other welding methods, but there is a vastly larger field of work you can handle economically and efficiently by the Prest-O-Lite Process.

In manufacturing or repair work—wherever two pieces of metal are to be joined—oxy-acetylene welding offers you opportunities for greater savings. As a routine production process in the manufacture of thousands of metal products, it is paying substantial dividends—handling the work quicker, better and at lower cost.

For "on the spot" repair work, it is without equal. The outfit is truly portable—can be easily taken to any desired point and the repair quickly made.

*Write for engineering data on any phase of welding work. We'll be glad to point out the possibilities this process has for you.*

**The Prest-O-Lite Company, Inc.**

*The World's Largest Makers of Dissolved Acetylene.*

Main Office and Factory, 852 Speedway, Indianapolis, Ind.
Canadian Office and Factory, Merritton, Ontario, Canada.

**Prest-O-Lite PROCESS**


*Alphabetical Index to Advertisers and Buyers' Index, Page 4.

# The largest makers of Oxy-Acetylene Welding and Cutting Equipment and Supplies in the World

**Oxweld Equipment** includes Acetylene Generators, Welding and Cutting Blow Pipes, Regulators and Supplies—everything needed for all requirements—complete installations for the most extensive manufacturing and repair operations to portable units for emergency and field use. Because of the scientific accuracy and exactness of design—high quality materials and the mechanical perfection of construction and workmanship, **OXWELD EQUIPMENT** will produce the most efficient and economical results in welding and cutting operations of every character.

**Oxweld Supplies** are made up in accordance with the formulae of our metallurgists—tested by analysis in our laboratory and their merits tested out and proven by our expert welders in actual shop practice. We guarantee **OXWELD SUPPLIES,** when used by competent welders, to produce better results than any others known to the art today.

Our knowledge and experience, as the largest makers of welding and cutting equipment in the world, are always at the service of every purchaser and prospective purchaser of **OXWELD APPARATUS,** to determine the most economical and efficient applications of the **PROCESS** to the manufacturing or repair problems at hand.

***Write us for information on any class of Welding or Cutting Work***

## Oxweld Acetylene Company

**CHICAGO**
**36th St. and Jasper Place**

**NEWARK, N. J.**
**6460-680 Frelinghuysen Ave.**

**LOS ANGELES**
**654-656 Pacific Electric Bldg.**

# HAUCK PREHEATING TORCHES and BURNERS

**Reduce Expense and Make Welding a Success**

## Sell for $15.00 to $125.00

Some welders consider it necessary to only preheat heavy castings. In our own shop we preheat as small as ½" x ⅛" angle iron and are always sure of perfect welds; whereas, when this welding work was done without preheating, we did not always make perfect welds; and by this preheating method we reduce the time of welding 75% and save 60% oxy-acetylene gas.

**Ask for Free Book**
***HOW and WHY to Weld and Braze***

**HAUCK MFG. CO., Brooklyn, N.Y.**

# Huge Stacks Felled In Record Time

**By Means of**

## Imperial OXY-ACETYLENE EQUIPMENT

The gigantic task of dismantling the huge Harrison Street Plant of the Commonwealth-Edison Company in Chicago was accomplished in record time by means of four outfits of

**IMPERIAL WELDING CUTTING EQUIPMENT**
**OXY-ACETYLENE PROCESS**

The base of each of the eight stacks was cut by the flame in carefully selected places so as to undermine it. Mammoth engines, generators, fly-wheels, forty-two 360 H. P. boilers, coal hoppers—seemingly immovable, have also been reduced to small, easily handled pieces of scrap, as if by magic, by the Imperial Cutting Torch.

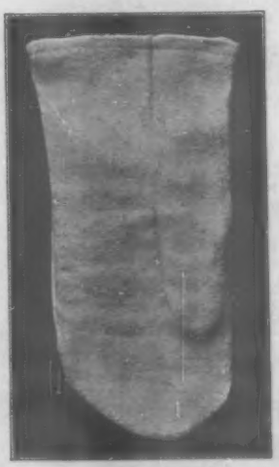
And so the good word of Imperial performance on big jobs goes along—first in SAFETY, SPEED of ACCOMPLISHMENT and ECONOMY of OPERATION.

If you are planning to purchase new equipment or are not satisfied with your present outfit, end all your troubles by getting an Imperial Equipment NOW.

Write for catalogue giving pictures of work actually accomplished, cost of operation and other valuable data.

**IMPERIAL BRASS MFG. CO.**
**522 So. Racine Ave. :: CHICAGO**

# ASBESTOS



**Gloves,
Mittens,
Leggings,
Aprons,
Pants,
Coats,
Fingers,
Patching Pieces,
Specialties,
Cloth,
Yarns.**

We manufacture and are prepared to furnish promptly, at reasonable cost, asbestos garments of all descriptions. They are all treated by our own special process, which prevents the nap rubbing off, giving added life and tensile strength to fabric.

We are prepared to furnish anything in the asbestos line.

**MIKESELL BROTHERS COMPANY**
Dept. S 178 N. La Salle St., Chicago

# Buyers' Index

*Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.*

**ACETYLENE (Compressed in Cylinders)**
Commercial Acetylene Welding Co.
The Prest-O-Lite Co., Inc.
Universal Oxygen Co.

**ACETYLENE CYLINDERS**
Janney-Steinmets Co.

**ACETYLENE GENERATORS**
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Indiana Oxygen Co.
The Harris Calorific Co.
Metals Welding Plant
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.

**ALUMINUM FILLER RODS**
American Welding Co.
Fidelity Brass Mfg. Co.
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Hauck Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Mach. Co.
United States Welding Co.
Universal Oxygen Co.

**ALUMINUM FLUX**
American Welding Co.
Fidelity Brass Mfg. Co.
American Oxygen Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Hauck Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

**ALUMINUM SOLDER**
So. Luminum Mfg. & Eng. Co.

**ANNEALING FURNACES**
Buffalo Dental Mfg. Co.
Universal Oxygen Co.

**APRONS (Asbestos)**

**ASBESTOS GLOVES**

**ASBESTOS SHEET PAPER**
American Oxygen Co.
Davis-Bournonville Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

**BLOW TORCHES (Acetylene)**
American Welding Co.
American Oxygen Co.
Fidelity Brass Mfg. Co.
Bermo Welding Apparatus Co.
Buffalo Dental Mfg. Co.
Hauck Mfg. Co.
Indiana Oxygen Co.
Metals Welding Plant
The Alexander Milburn Co.
The Prest-O-Lite Co.

**BOOKS (Relating to Welding)**
The Welding Engineer

**BRASS AND BRONZE FLUX**
American Welding Co.
American Oxygen Co.
Hauck Mfg. Co.
Fidelity Brass Mfg. Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
United States Welding Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.

**BRASS SPELTER WIRE**
American Oxygen Co.
Indiana Oxygen Co.
Universal Oxygen Co.

**BRAZING OUTFITS**
Buffalo Dental Mfg. Co.
Hauck Mfg. Co.
Superior Oxy-Acetylene Machine Co.

**BRONZE FILLER RODS**
American Oxygen Co.
Hauck Mfg. Co.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Fidelity Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

**BUTT WELDERS (Electric Resistance)**
Thomson Electric Welding Co.

**CARBIDE (Calcium)**
American Carbolite Sales Co.
Union Carbide Sales Co.
Canada Carbide Sales Co.

**CARBON REMOVING TORCHES**
American Welding Co.
American Oxygen Co.
The Bastian-Blessing Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
Ideal Bronze Co.
General Welding & Equipment Co.
The Harris Calorific Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Fidelity Brass Mfg. Co.
Indiana Oxygen Co.
Messer & Co.
Metals Welding Plant
The Alexander Milburn Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Mach. Co.
Universal Oxygen Co.

**CAST IRON FILLER RODS AND FLUX**
American Welding Co.
American Oxygen Co.
Bermo Welding Apparatus Co.
Bierman-Everett Fdy. Co.
Davis-Bournonville Co.
Fidelity Brass Mfg. Co.
Hauck Mfg. Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

**ELECTRIC ARC WELDING OUTFITS**
Westinghouse Electric & Mfg. Co.
General Electric Co.

**ELECTROLYTIC OXYGEN PLANTS**
Universal Oxygen Co.

**FILLER RODS (Aluminum)**
American Welding Co.
American Oxygen Co.
Bierman-Everett Fdy. Co.
Hauck Mfg. Co.
Indiana Oxygen Co.
United States Welding Co.
The Prest-O-Lite Co.

**FILLER RODS (Swedish Iron)**
American Welding Co.
American Oxygen Co.
Bierman-Everett Fdy. Co.
Indiana Oxygen Co.
Apex Steel Corporation.
Bermo Welding Apparatus Co.
Davis-Bournonville Co.
Fidelity Brass Mfg. Co.
Hauck Mfg. Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.

**FILLER RODS (Tobin Bronze)**
American Welding Co.
American Oxygen Co.
Bermo Welding Apparatus Co.
Bierman-Everett Fdy. Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

**FILLER RODS (Vanadium Steel)**
American Welding Co.
American Oxygen Co.
Bermo Welding Apparatus Co.
Bierman-Everett Fdy. Co.
Davis-Bournonville Co.
Hauck Mfg. Co.
The Imperial Brass Mfg. Co.
Indiana Oxygen Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Fidelity Brass Mfg. Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

**FIREPROOF PLASTIC**
Fidelity Brass Mfg. Co.
Bermo Welding Apparatus Co.

**FLUX WELDERS (Electric)**
Westinghouse Electric & Mfg. Co.

**FURNACES (Annealing)**
Buffalo Dental Mfg. Co.
Hauck Mfg. Co.
Universal Oxygen Co.

**GASOLINE PREHEATING FURNACES**
Buffalo Dental Mfg. Co.
Hauck Mfg. Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Machine Co.

**GAS BURNERS (Preheating)**
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.
Westinghouse Electric & Mfg. Co.

**GLOVES (Asbestos)**
Mikesell Bros. Co.
United States Welding Co.

**GLOVES (Welders Asbestos)**
Davis-Bournonville Co.
Mikesell Bros. Co.

**GOGGLES**
William C. Adams.
Chicago Eye Shield Co.
F. A. Hardy & Co.

**HARDENING FURNACES**
Buffalo Dental Mfg. Co.
Hauck Mfg. Co.

**HOSE (Oxygen and Acetylene)**
American Welding Co.
American Oxygen Co.
Bermo Welding Apparatus Co.
Buffalo Dental Mfg. Co.
Davis-Bournonville Co.
Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co
The Prest-O-Lite Co.
United States Welding Co.
Universal Oxygen Co.

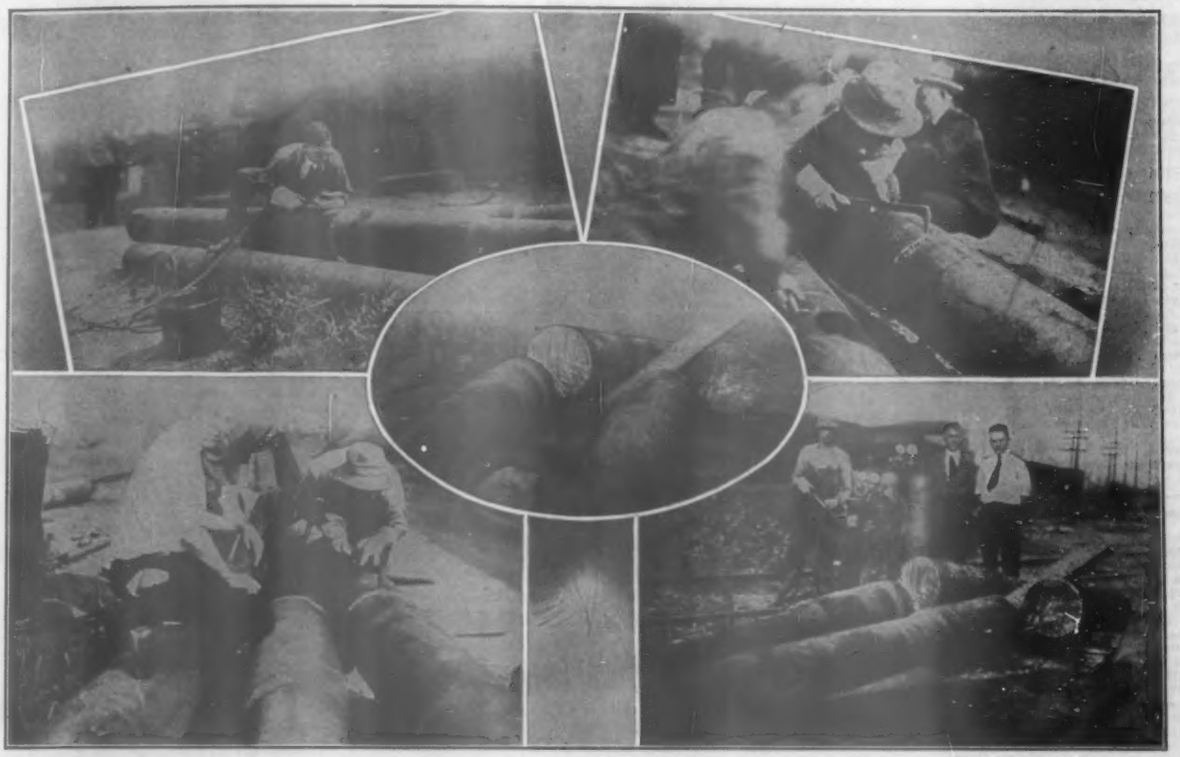
**HOSE UNIONS**
Bermo Welding Apparatus Co.
K-G Welding & Cutting Co.
Hauck Mfg. Co.
Superior Oxy-Acetylene Machine Co.

**HYDROGEN**
American Oxygen Co.
Carbo-Hydrogen Co.
Indiana Oxygen Co.
Universal Oxygen Co.

**KEROSENE PREHEATING TORCHES**
Alger Supply Co.
Hauck Mfg. Co.
Fidelity Brass Mfg. Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.

**NEEDLE VALVES**
American Oxygen Co.
Indiana Oxygen Co.
The Bastian-Blessing Co.
Bermo Welding Apparatus Co.
Buffalo Dental Mfg. Co.
K-G Welding & Cutting Co.
Superior Oxy-Acetylene Machine Co.

# Cutting 14½" 15½" 16½" Shafting
## With a Davis-Bournonville Oxy-Acetylene Torch



14½ in. Time, 17 minutes. 15½ in. Time, 12 minutes.
Cut with Davis-Bournonville Oxy-Acetylene Torch.
16½ in. Time, 16 minutes. After the cutting.

Since the introduction of the Oxy-Acetylene process of welding and cutting ten years ago, Davis-Bournonville apparatus has been the standard of efficiency and for comparison of less efficient apparatus.

During that time the apparatus has been continuously improved in advance of and in anticipation of more extended application of the Oxy-Acetylene process to all metal working lines.

Davis-Bournonville apparatus is employed extensively by the largest industries in the United States and Canada, for welding in the manufacture of metal products and on repair work, and for steel cutting and reclamation in foundries, steel mills, shipbuilding and navy yards, railroad and locomotive shops, and in the scrap yards.

**Davis Apparatus Leads the World**
**In Range, Efficiency, and Apparatus in Successful Use**

## DAVIS-BOURNONVILLE COMPANY
**NEW YORK** **CHICAGO**

**General Offices and Factory, Jersey City, N. J.**

New York, Philadelphia, Cleveland, Boston, Pittsburgh, Cincinnati, Chicago, St. Louis, San Francisco, Detroit, Seattle, Toronto

DAVIS-BOURNONVILLE CO. DAVIS APPARATUS NEW YORK • CHICAGO

**OIL BURNERS (Preheating)**
Alger Supply Co.
Oxweld Acetylene Co.
Fidelity Brass Mfg. Co.
Superior Oxy-Acetylene Mach. Co.

**OXYGEN (Compressed in Cylinders)**
American Oxygen Co.
Burdett Oxygen Co.
Indiana Oxygen Co.
Logansport Oxygen Co.
Ohio Electrolytic Oxygen Co.
The Linde Air Products Co.
Swift & Co.
Universal Oxygen Co.

**OXYGEN CYLINDERS**
Janney-Steinmetz Co.

**PIPE WELDING**
Goldschmitt Thermit Co.

**PHOTOGRAPHS**
Chicago Architectural Photographing Co., (Specialists in photographs relating to the welding industry)

**PLASTIC (Fireproof)**

**PRESSURE GAUGES**
American Welding Co.
American Oxygen Co.
Indiana Oxygen Co.
Bastian & Blessing Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
Fidelity Brass Mfg. Co.
Hauck Mfg. Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
U. S. Gauge Co.
United States Welding Co.
Universal Oxygen Co.

**RAILROADS—Special Service for**
American Oxygen Co.
Indiana Oxygen Co.
Oxweld Railroad Service Co.

**REGULATING VALVES (Acetylene)**
American Welding Co.
American Oxygen Co.
Indiana Oxygen Co.
The Bastian-Blessing Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
Fidelity Brass Mfg. Co.
Hauck Mfg. Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
The Prest-O-Lite Co., Inc.
United States Welding Co.
Universal Oxygen Co.

**REGULATING VALVES (Hydrogen)**
American Welding Co.
American Oxygen Co.
Indiana Oxygen Co.
The Bastian-Blessing Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
The Prest-O-Lite Co.
The Imperial Brass Mfg. Co.
Fidelity Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.

**REGULATING VALVES (Oxygen)**
The Bastian-Blessing Co.
American Welding Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
The Imperial Brass Mfg. Co.
Fidelity Brass Mfg. Co.
K-G Welding & Cutting Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

**SCHOOLS OF WELDING**
Michigan State Auto School.

**SEAM WELDERS (Electric)**
General Electric Co.
Westinghouse Electric & Mfg. Co.

**SEAM WELDERS (Electric Resistance)**
Thomson Electric Welding Co.

**SPOT WELDERS (Electric Resistance)**
Thomson Electric Welding Co.

**TANK CONNECTIONS (Oxygen and Acetylene Adaptors)**
Superior Oxy-Acetylene Machine Co.

**THERMALENE-GAS**
The Thermalene Co.

**THERMIT WELDING**
Goldschmidt-Thermit Co.

**TORCHES (Gasoline and Kerosene Preheating)**
American Welding Co.
Alger Supply Co.
Buffalo Dental Mfg. Co.
General Welding & Eq. Co.
The Bishop-Babcock-Becker Co.
The Imperial Brass Mfg. Co.
Hauck Mfg. Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Westinghouse Electric & Mfg. Co.

**TORCHES (Oxy-Acetylene Cutting)**
American Welding Co.
American Oxygen Co.
Indiana Oxygen Co.
Bermo Welding Apparatus Co.
Ideal Bronze Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
General Welding & Eq. Co.
Fidelity Brass Mfg. Co.
The Harris Calorific Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Messer & Co.
Welding Supply Co.
K-G Welding & Cutting Co.
Metals Welding Plant
The Alexander Milburn Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Machine Co.
The Thermalene Co.
United States Welding Co.
Universal Oxygen Co.

**TORCHES (Oxy-Acetylene Welding)**
American Welding Co.
American Oxygen Co.
Indiana Oxygen Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Davis-Bournonville Co.
Fidelity Brass Mfg. Co.
Ideal Bronze Co.
General Welding & Eq. Co.
The Harris Calorific Co.
Messer & Co.
Welding Supply Co.
Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Metals Welding Plant
The Alexander Milburn Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co., Inc.
Superior Oxy-Acetylene Machine Co.
The Thermalene Co.
United States Welding Co.
Universal Oxygen Co.

**TORCHES (Oxy-Hydrogen Cutting)**
American Welding Co.
American Oxygen Co.
Indiana Oxygen Co.
Bermo Welding Apparatus Co.
The Bishop-Babcock-Becker Co.
Fidelity Brass Mfg. Co.
Davis-Bournonville Co.
Messer & Co.
Welding Supply Co.
General Welding & Eq. Co.
Ideal Bronze Co.
The Harris Calorific Co.
Henderson-Willis Welding & Cutting Co.
The Alexander Milburn Co.
The Imperial Brass Mfg. Co.
Vulcan Process Co.
Metals Welding Plant
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.

**TORCHES (Oxy-Hydrogen Welding)**
American Welding Co.
American Oxygen Co.
Indiana Oxygen Co.
Bermo Welding Apparatus Co.
Messer & Co.
Welding Supply Co.
Ideal Bronze Co.
The Bishop-Babcock-Becker Co.
Buffalo Dental Mfg. Co.
Davis-Bournonville Co.
Fidelity Brass Mfg. Co.
Vulcan Process Co.
General Welding & Eq. Co.
The Harris Calorific Co.
Henderson-Willis Welding & Cutting Co.
Metals Welding Plant
The Imperial Brass Mfg. Co.
The Alexander Milburn Co.
Oxweld Acetylene Co.
United States Welding Co.
Universal Oxygen Co.

**TORCHES (Special to Order)**
American Welding Co.
Bermo Welding Apparatus Co.
Fidelity Brass Mfg. Co.
The Bishop-Babcock-Becker Co.
The Harris Calorific Co.
Superior Oxy-Acetylene Machine Co.

**TRUCKS (Cylinder Carriers)**
American Welding Co.
American Oxygen Co.
Indiana Oxygen Co.
Davis-Burnonville Co.
The Imperial Brass Mfg. Co.
Oxweld Acetylene Co.
The Prest-O-Lite Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

**VALVES (For Oxygen Cylinders)**
American Oxygen Co.
Indiana Oxygen Co.
The Bastian-Blessing Co.
International Oxygen Co.
Universal Oxygen Co.

**WELDING (Electric Resistance-Custom Work)**
Thomson Electric Welding Co.

**WELDERS' GOGGLES**
William C. Adams.
Chicago Eye Shield Co.
Fidelity Brass Mfg. Co.

**WELDING (Oxygen for)**
American Oxygen Co.
Indiana Oxygen Co.
International Oxygen Co.
The Linde Air Products Co.
Universal Oxygen Co.

**WELDING RODS**
Bierman-Everett Fdy. Co.

# ALPHABETICAL INDEX TO ADVERTISERS


**A**
Adams, William C..... 12
Alger Supply Company..... 14
American Oxygen Co..... 12
Apex Steel Corporation..... 15
American Welding Co..... 10

**B**
The Bastian-Blessing Co..... 8
Bermo Welding Apparatus Co..... 49
Bierman-Everett Fdy. Co..... 50
The Bishop-Babcock-Becker Co..... 47
Buffalo Dental Mfg. Co..... 17
Burdett Oxygen Co..... 45

**C**
Canada Carbide Sales Co..... 11
Carbo-Hydrogen Co..... 17
Chicago Eye Shield Co..... 47
Commercial Acetylene Welding Co..... 43

**D**
Davis-Bournonville Co..... 5
M. Keith Dunham..... 49

**F**
Fidelity Brass Mfg. Co..... 15

**G**
General Welding & Equipment Co..... 49
General Electric Co..... 16
Goldschmidt Thermit Co.....Back cover

**H**
The Harris Calorific Co..... 47
Henderson-Willis Welding & Cutting Co... 15
F. A. Hardy & Co..... 12
Hauck Mfg. Co..... 3

**I**
Ideal Bronze Co..... 49
Imperial Brass Mfg. Co..... 3
Indiana Oxygen Co..... 12

**J**
Janney-Steinmetz Co. ..... 9

**K**
K-G Welding & Cutting Co..... 14

**L**
Linde Air Products Co..... 18
Logansport Oxygen Co..... 12

**M**
Messer & Co. ..... 50
Michigan State Auto School..... 49
Mikesell Bros. Co..... 3
The Alexander Milburn Co..... 17
The Metals Welding Plant..... 14

**O**
Ohio Electrolytic Oxygen Co..... 12
Oxweld Acetylene Co..... 2
Oxweld Railroad Service Co..... 13

**P**
Prest-O-Lite Co., Inc.....Front cover

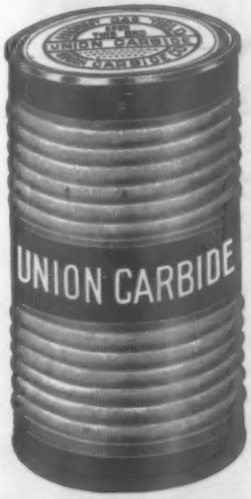
**S**
So. Luminum Mfg. & Eng. Co..... 49
Superior Oxy-Acetylene Machine Co..... 49
Swift & Co. ..... 11

**T**
The Thermalene Co..... 8
Thomson Electric Welding Co..... 13

**U**
Union Carbide Sales Co..... 7
United States Welding Co..... 49
Universal Oxygen Co..... 9
U. S. Gauge Co..... 8

**V**
Vulcan Process Co..... 17

**W**
Westinghouse Electric & Mfg. Co.....
.....Inside Back Cover
Welding Supply Co..... 9
Winfield Elec. Weld. Mach. Co..... 49




Packed in Blue and Gray Drums

# Union Carbide Sales Company

**New York City, 42nd St. Building** — **Chicago, Ill., Peoples Gas Building** — **San Francisco, Cal., Kohl Building**

*SOLE DISTRIBUTORS OF*

# UNION CARBIDE

**"World's Best Quality—Highest Gas Yield"**

## For Oxy-Acetylene Welding Plants

**Contractors' Flare Lights, Torches and Private and Municipal Lighting Plants**

"Union Carbide" is packed in 100-lb. blue and gray drums marked conspicuously, "UNION CARBIDE."

The following sizes are carried in stock in 100-lb. drums:

**$3\frac{1}{2}$ x 2 in.** —a large size.

**2 x $\frac{1}{2}$ in.** —a medium size.

**$1\frac{1}{4}$ x $\frac{3}{8}$ in.** —an intermediate size.

**$\frac{1}{4}$ x 1/12 in.** —finely crushed size.

Union Carbide in the Generator sizes above listed will be shipped direct to consumers from a **Union Carbide Sales Co.** warehouse at any one of the following points where large stocks are kept on hand:

**ALABAMA**
Birmingham—1916 Morris Ave.
Mobile—262-268 S. Water St.
Montgomery—114 N. Perry St.
**ARIZONA**
Phoenix—42 S. Central Ave.
**ARKANSAS**
Fort Smith—109-123 So. Ninth St.
**CALIFORNIA**
Eureka—109 Second St.
Fresno—932 H St.
Los Angeles—639 Gibbon St.
Sacramento—1523-31 Front St.
San Diego—326-336 Fifth St.
San Francisco—Kohl Building.
**COLORADO**
Denver—Nineteenth and Wazee Sts.
Victor—Third and Diamond Sts.
**CONNECTICUT**
Hartford—877 Main St.
**DISTRICT OF COLUMBIA**
Washington—Maryland Ave. and 9th St., S. W.
**FLORIDA**
Jacksonville—106 E. Forsyth St.
Tampa—413 Tampa St.
**GEORGIA**
Atlanta—Cor. Haynes and Rhodes Sts., P. O. Box 1594.
Savannah—Ogeechee Canal, South of Bay St., P. O. Box 78.
**ILLINOIS**
Chicago—Peoples Gas Bldg., Michigan Blvd.
Decatur—133-147 W. Williams St.
East St. Louis—600 Walnut Ave.
Peoria—731-731 So. Washington St.
Marion—815 S. Granite St., Box 747.
Monmouth—601 S. First St.
Quincy—222 S. Eighth St.
Streator—703 East Elm St.
**INDIANA**
Evansville—1601 Illinois St.
Indianapolis—110-112 S. Alabama St.
Terre Haute—931 Wabash Ave.
**IOWA**
Des Moines—117-119 Fifth St.
Dubuque—8th and Washington Sts.
Ottumwa—207-9-11 S. Washington St.
Sioux City—925 Fourth St., P. O. Box 398.
**KANSAS**
Pittsburg—109 W. Third St.
Salina—154 So. 5th St.
Wichita—721 Beacon Building.
**KENTUCKY**
Louisville—126 E. Main St.
Middlesboro—
**LOUISIANA**
New Orleans—819-21 Julia St.
**MAINE**
Portland—202 Commercial St.
**MARYLAND**
Baltimore—19 E. Lombard St.
Cumberland—1 N. Liberty St.
Salisbury—Opp. Fulton Station.
**MASSACHUSETTS**
Boston—(See Cambridge "A.")
Cambridge—241 Albany St.
Springfield—Napier St.
**MICHIGAN**
Detroit—Jefferson Ave. and Orleans St.
Grand Rapids—500 Shawmut Ave., N. W.
Hancock—First National Bank Bldg.
Iron Mountain—215 E. A St.
Jackson—172 South Water St.
Saginaw—1902 N. Michigan Ave.
Sault Ste. Marie.
**MINNESOTA**
Minneapolis—324 N. First St.
Virginia—413 Chestnut St.
**MISSISSIPPI**
Vicksburg—1212 Washington St.
**MISSOURI**
Kansas City—1316-1318 W. Eighth St.
St. Joseph—920 S. Sixth St., Sta. "A."
St. Louis—(See East St. Louis, Ill.)
**NEBRASKA**
Omaha—1007-9-11 Jones St., Union Sta. P. O.
**NEW HAMPSHIRE**
Concord—77 South Main St.
**NEW JERSEY**
Camden—657 So. Second St.
Jersey City—554-56 Henderson St.
**NEW YORK**
Albany—Montgomery and Colonie Sts.
Binghamton—31 Jarvis St.
Geneva—Exchange St. and Railroad Pl.
Jamaica—11 New York Ave.
Kingston—O'Neil St., near Broadway.
New York City—42nd St. Building.
Niagara Falls.
Poughkeepsie—Smith St. and N. Y., N. H. & H. R. R. Tracks.
Roscoe.
Utica—127 Hotel St.
Watertown—438 Court St.
Whitehall—57 Canal St.
**NORTH CAROLINA**
Wilmington—Room 16 Masonic Temple, 13 N. Front St.
**NORTH DAKOTA**
Fargo—17-19 Broadway.
**OHIO** Cincinnati—63-65 Plum St.
Cleveland—601 The Citizens' Building.
Columbus—310 Dublin Ave.
Dayton—812-828 E. First St.
Lima—338 East High St.
Toledo—414 S. Erie St.
Zanesville—Main and Second Sts.
**OKLAHOMA**
Oklahoma City—27-29 E. Grand Ave.
**OREGON**
Portland—Fifteenth and Hoyt Sts.
**PENNSYLVANIA**
Beaver.
Du Bois—Weber Ave. and Franklin St.
Erie—1426 Chestnut St.
Harrisburg—627 Walnut St.
Johnstown—129 Jackson St.
Pittsburgh—32nd St. and Penn. R. R.
Pottsville—Railroad and Sanderson Sts.
Scranton—4 Cliff St.
Shamokin—46 West Independence St.
Williamsport—Canal and Court Sts.
**RHODE ISLAND** ..... ..... ....
Providence—Allen's Ave., P. O. Box 419.
**SOUTH CAROLINA**
Charleston—153 Church St.
**TENNESSEE**
Chattanooga—700 E. Tenth St.
Knoxville—426 West Depot Ave.
Memphis—671 South Main St.
Nashville—105-107-109 Broadway.
**TEXAS**
Dallas—802-810 Cadiz St.
El Paso—900 Overland St.
Houston—Baker and Cedar Sts., Box 745.
San Antonio—Cor. Leal and N. Salado Sts.
Waco—623 S. 7th St.
**UTAH**
Salt Lake City—118 W. Second South St.
**VERMONT**
Burlington—College and Champlain Sts.
**VIRGINIA**
Lynchburg—1324 Commerce St.
Norfolk—Cor. First and Front Sts.
Richmond—18th and Cary Sts.
**WEST VIRGINIA**
Bluefield—195 Roanoke St.
Charleston—Broad St. and K. & M. R. R.
Fairmont—"A" Street.
Huntington—820 3rd Avenue.
**WASHINGTON**
Seattle—1102 First Ave.
Spokane—646 Peyton Building.
**WISCONSIN**
La Crosse—Front and King Streets.
Madison—309 East Wilson St.
Milwaukee—130-134 Jefferson St.

We recommend our customers to select from the list, the city from which the quickest delivery and lowest freight rate can be obtained, and address their orders to "Union Carbide Sales Company" at the distributing point selected accompanied by remittance.

Please address request for information or special correspondence to either the Chicago or New York office.

# THE BASTIAN-BLESSING COMPANY

125-131 W. Austin Ave.
CHICAGO, ILLINOIS

## OXYGEN DRUM VALVE

Operating one of the finest brass shops in America, we specialize in drum valves, torches, safety valves, apparatus parts, needle valves, etc. Send us your specifications.

Our acetylene and oxygen regulators are pre-eminent for accuracy, volume of delivery, range and fineness of adjustment, strength, reliability—every desirable quality.

Write for our catalog.

*We Sell Manufacturers and Jobbers only*

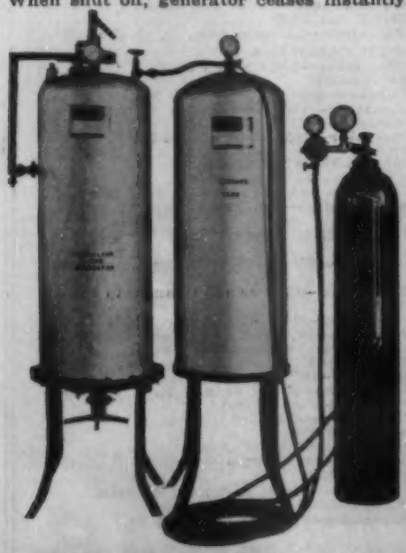
REGO TRADE MARK

THERMALENE

## The Oxy-Thermalene Method
### of Welding, Cutting, Brazing, Etc.

**The only Acetylene Oil Gas generator in the world. Saves 25% on gas and oxygen. First class references. We also sell complete Oxy-Acetylene equipment for dissolved Acetylene for $42.00.**

**Thermalene gas in conjunction with Oxygen gas produces the ideal flame for welding and cutting. There is no loss of time due to shortage of gas. The generator works only when you work. When shut off, generator ceases instantly.**



**Thermaline will not produce faulty welds due to impure and moist gas. The generator may be mounted on a truck and made portable.**

**Thermaline Gas, being heavier and richer than Acetylene and other gases, has more body, producing a softer non-oxidizing flame, which assures a more uniform weld and a cleaner cut, without burning or making the metal brittle.**

**Write for full information, catalog and prices.**

**THE THERMALENE COMPANY**
**Chicago Heights, Ill.**

THERMALENE

# U.S. Gauge Company
## New York

The GENERAL WELDING & EQUIPMENT CO. has adopted the U. S. GAUGE as standard on their equipment. Its record in service, together with distinctive patented safety features commend it to the best trade.

## New York, 67 Wall St.

Chicago, Clark Street Bridge.

San Francisco, 681 Market Street.

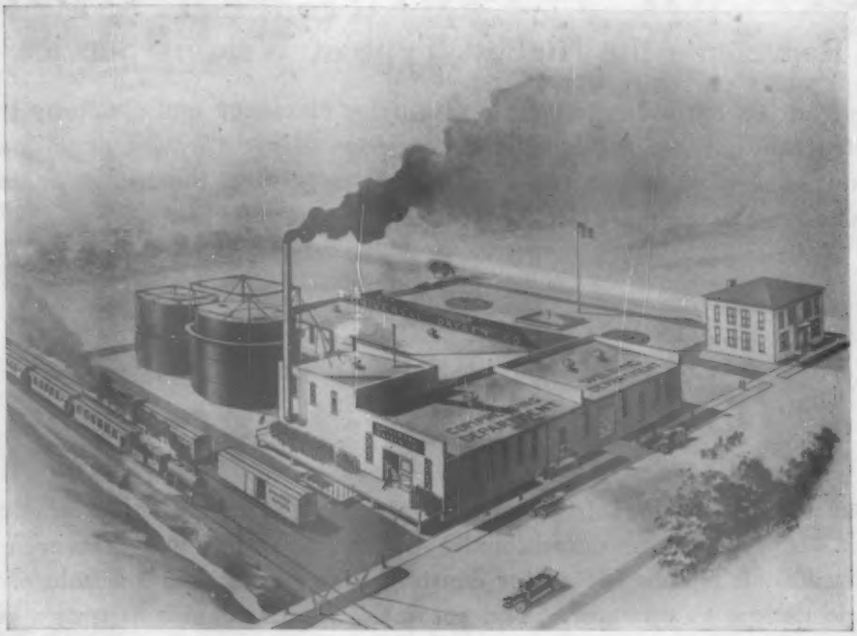
Detroit, 42 W. Larned Street.

Montreal, Board of Trade.

**Works: Sellersville, Pa.**

# THE PUREST OXYGEN and HYDROGEN

99.6% Pure Oxygen



100% Pure Hydrogen

## UNIVERSAL OXYGEN COMPANY

SHEBOYGAN, WIS., U. S. A.

SEAMLESS STEEL
OXYGEN CYLINDERS
BUREAU EXPLOSIVE SPECIFICATIONS

HYDROGEN CYLINDERS
BALLOON SIGNAL SERVICE

High & Low Pressure "JASCO" Seamless Tanks

Forged Bronze Valves for High Pressure Gas

MALLEABLE IRON PROTECTOR CAPS

JANNEY-STEINMETZ
Philadelphia and New York

## Welding Supply Co., Inc.

132 Nassau Street, New York

Seamless and Welded TANKS

Cast, Forged and Pressed High Pressure Cylinder VALVES

Ask for Our Valve Catalog

Welding Apparatus and Supplies

# American Welding Equipment

## Represents the Highest Type of Welding Service

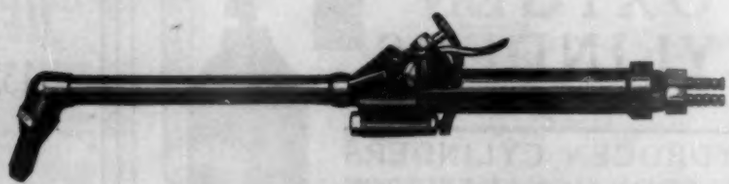
THE American has earned an enviable record for efficiency and economy in operation. Its construction is based on thorough knowledge gained through experience in actual practice. Your success or failure as a welder rests largely on the tools you use. Unless your torch is as good as the AMERICAN you can not do your best.

American Welding Torch—Injector Type

The American Torch is of the Injector type, recognized to be the most efficient type of welding torch. It works on an exceptionally low pressure, therefore drawing every ounce of gas from tanks. It is constructed for constant heavy duty and is absolutely free from back firing and danger to operator. The automatic mixing device assures a perfect mixture of gas, regardless of the varying pressures, or size of tip used. This insures a neutral flame at all times, so necessary to good welding. This is an important point for the beginner to keep in mind.

## Cutting Torches

The low gas consumption and perfect control give a smooth, clean cut at a rate of speed that is astonishing.



Cuts metals from 1/8" to 8" in thickness. Cutting heads are made of heat-resisting alloy which will withstand constant severe heat.

## Knocked-Down Trucks $10.00

Boxed and easily assembled. Weight, 55 lbs. Capacity, one tank each oxygen and acetylene.

**Write for Catalog.**

## American Welding Co., Inc.

2724-26 Michigan Boulevard

Chicago, Ill., U. S. A.

# Swift Oxygen

## For Welding and Cutting

***Unsurpassed for Quality***

Pure Oxygen Electrolytically Made under the direct supervision of our Chemical Laboratory. It is carefully controlled by chemical analysis, thus insuring the highest obtainable purity.

We carry a large stock on hand so can fill orders immediately.

## Swift & Company

**Oxygen Department** **Union Stock Yards, Chicago, Ill.**

## Canada Carbide Sales Company

**30 Church Street, NEW YORK CITY**

**WORKS**
**Shawinigan Falls, Que.**
**Merritton, Ont.**

***Sales Agents of***

## CANADIAN CARBIDE

**"More gas per pound"**

**SIZE PKGS.**
**100 lb. and 1,000 lb. 25-lb. drums; 10 lb., 5 lb., 2 lb., 1lb. tins**

**DISTRIBUTING STATIONS**

**ALABAMA**
Bessemer—2014-2024 Second Ave.
**CALIFORNIA**
Los Angeles—52nd St. and Santa Fe Ave.
San Francisco—731 Market St.
**ILLINOIS**
Chicago—105 W. Monroe St.
**INDIANA**
Terre Haute—15 No. Eighth St.
**IOWA**
Knoxville.
Centerville.
Albia.
**LOUISIANA**
New Orleans—Camp and Common Sts.
**MARYLAND**
Baltimore—17 So. Hanover St.
**MASSACHUSETTS**
Boston—47 Oliver St.
Springfield—50 Taylor St.
**MICHIGAN**
Detroit—343 Bellevue Ave.
**MINNESOTA**
Duluth—Third Ave. E. and Michigan St.
**MISSOURI**
Joplin—Opposite Post Office.
**NEW JERSEY**
Newark—See New York.
Paterson—41-43 Washington St.
**NEW YORK**
Buffalo—Seneca and Hamburg Sts.
Malone—32-34 W. Main St.
Middletown—38 W. Main St.
New York—30 Church St.
Troy—6 and 8 Grand St.
Trumansburg—56 Main St.
Valley Stream.
Watertown—112 Franklin St.

***Manuf'd in all standard sizes***

**DISTRIBUTING STATIONS**

**OHIO**
Toledo—Address Detroit.
Barton.
**PENNSYLVANIA**
Barnesboro—Ann St. and Maple Ave.
Johnstown—134 Clinton St.
Montrose.
Pittsburgh—520 Farmers Bank Bldg.
Pottsville—Centre and Market Sts.
Punxsutawney.
Scranton—329 Penn Ave.
Wilkes-Barre.
**RHODE ISLAND**
Providence—542 Charles St.
**TENNESSEE**
Knoxville—1761 Asylum Ave.
**TEXAS**
El Paso—22 Mills Bldg.
Fort Worth—23rd and Jones Sts.
Houston—Address Fort Worth.
**UTAH**
Salt Lake City—121 W. 2nd South St.
**VERMONT**
Burlington—Park Ave.
**VIRGINIA**
Richmond—1219 E. Main St.
**WEST VIRGINIA**
Charleston—821 Virginia St.
Clarksburg—603 Goff Bldg.
Huntington—1033 Third Ave.

***For special information address correspondence to New York City.***

# Welders' Goggles
and
# Protection Glasses

Our specialty is eye production for industrial purposes.

We keep in touch with the needs of the trade and adopt every new invention applicable to this growing industry.

We shall show, from time to time, in this magazine the new items as they come up.

Write for our new 1917 catalog.

## Pfund Welders' Goggles

Pfund lenses are the latest improvement in glass for welders. They are made up of a combination of a strong, colorless optical lens and a lens of Sir William Crookes glass, with a thin film of 14K solid gold in between. A special process of fusing makes this combination of the three practically as solid as a single piece of glass, and of even greater blow-resisting qualities.

The clear glass side of the Pfund lens is worn on the outside, the Sir William Crookes side is worn next the eye. The film of gold acts as a reflector of the harmful infra red or heat rays, and transmits less than 2%. The Sir William Crookes glass does work by shutting out the ultra-violet rays. A large per cent of the visual light in welding operation comes from the incandescent sedium gases of the flux used to prevent oxidation. The bright yellow light may be absorbed without a marked loss in the visual and allow what is known as "seeing through" the frame. This special property of a glass is covered by the Pfund lens.

**Price, Per Pair, $5.00**

## William C. Adams

***Manufacturing Optician***

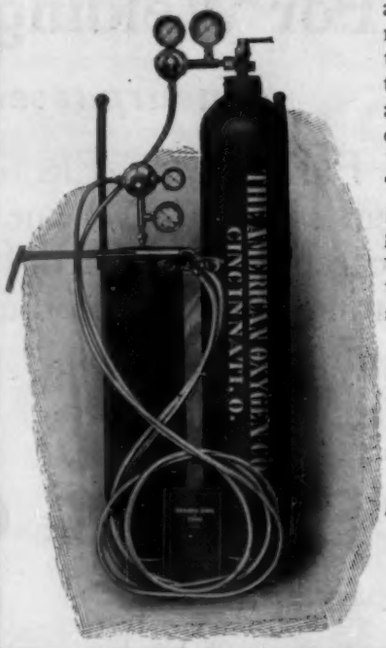
**332 Boylston St., Boston, Mass., U. S. A.**



# Pure Oxygen

Pure oxygen is essential to good work. If your oxygen supply is not up to the standard set by "American" and "Watergas" oxygen then the best welding and cutting apparatus to be had will not do your work properly.

We are glad to recommend "Vulcan" welding and cutting apparatus to our customers. No better tools are made and when used in connection with "American" and "Watergas" oxygen, with high grade acetylene, we know our customer will get results.

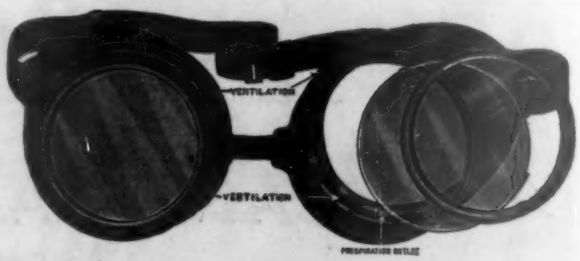



Write our nearest office for prices. Prompt shipments made at all times.

**American Oxygen Co.**
**Cincinnati**

**Indiana Oxygen Co.**
**Indianapolis**






# The Hardy Welding Goggle

**With Noviweld Lenses**

is now recognized as being the standard eye protector for the use of Oxweld Acetylene and Electric Welders.

The largest industrial plants in the country have standardized it and insist on their workmen using them.

**Write for Our Free Welding Goggle Book**

## F. A. HARDY & CO.

***JOHN H. HARDIN, Pres.***

| | | |
|---|---|---|
| **CHICAGO**<br>10 S. Wabash Ave. | **ATLANTA**<br>Grant Bldg. | **DALLAS**<br>Praetorian Bldg. |
| **NEW YORK**<br>29 E. 22nd St. | **SAN FRANCISCO**<br>Phelan Bldg. | **DENVER**<br>Gas & Electric Bldg. |

## MILBURN APPARATUS

Milburn mixing principle produces best work with minimum gas, and no flash backs, burnt tips, or other annoyances.

Exceptionally durable construction of torches insures long, satisfactory service. Regulators dependable and free from valve, diaphragm and gauge troubles.

Ask for Catalogue No. 35.

**The Alexander Milburn Company**
Baltimore, Maryland

**EFFICIENCY** of a weld not only depends on the manner in which it is executed, but also on the grade and amount of material used.

In view of this, our engineers have developed the highest grade of various welding materials known to the art.

**OXWELD RODS** are furnished in convenient packages and are made for every class of material that can be welded, whether it be copper, brass, aluminum, steel, low or high carbon, chrome vanadium or ordinary steel castings.

We maintain a complete staff of experts qualified to handle and supervise all lines of work.

## Oxweld Railroad Service Company

CHICAGO NEW YORK

Thomson Process
Electric Welding

## The High Speed Steel Situation

High Speed Steel is way up in the air.

Whether it will ever come down again it is hard to say, but certainly not for a long time—long enough for a Thomson Electric Welder to pay for itself several times over.

Even at its lowest there will still be a tremendous advantage in favor of Thomson process.

## And Its Remedy

Thomson Electric Welding gives you the advantage of making the hard wearing parts of high-speed steel while the non-wearing end can be made of cheap low-carbon metal

Countersinks, reamers, lathe, planer or shaper tools, center drills, screw drivers, cutter bars and thousands of articles now made of high cost steel can be made the Thomson way at less than 1/3 the cost—and just as serviceable.

It will pay you to investigate now.

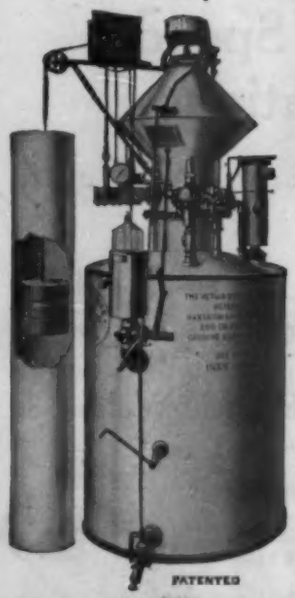
***Send for Illustrated Catalog***

## Thomson Electric Welding Co.

Originators of Electric Welding
Lynn, Mass.

# Cut Your Acetylene Bill 1/2

You can generate your own acetylene at half what it now costs to buy it in the tank.




**METWELD GENERATORS**

will produce acetylene for less than one cent per cubic foot and you will always have it on hand, in spite of freight and express delays or embargoes. The METWELD Generator is safe. Workmen cannot make mistakes in charging, or operating it.
It is approved by the Board of Underwriters—in fact, exceeds their requirements for safety.
You can put in a METWELD Generator and pay for it while it saves money for you.

***Write for Our Special Offer.***

**METALS WELDING PLANT**
**4401 Perkins Avenue, Cleveland, Ohio**

**Welding Grate Bars in the Manufacture of Smelter Grates**

A large stock of torches, regulators, gauges, reducing-valves, copper wire bound high pressure hose and plain black rubber gas hose, and all extra accessories and supplies for this line of work, is in our shops, New York City, at your demand.

The K-G Apparatus is accepted by those who know as the best money can buy. It is built to stand up.

This is not merely a statement of our opinion, but is proven by their universal adoption and long continued use.

**K-G Welding & Cutting Co., Inc.**
**Phone 6358 Greeley**
**556 West 34th St. New York City**

# Vulcan
## I-B Pre-heating Torch

A Portable, one-man torch, weight loaded 25 lbs.

Burns in any position. Gives a roaring flame 24 inches long, for one hour on one gallon of kerosene.

## You Need This Torch

Many a good welding job is ruined because of the lack of a first-class pre-heating torch. The Vulcan is rugged in construction, has no delicate parts and is easily operated. It is more efficient because the oil is practically gassed before burning. It does the work and does it cheaply.

***Write for Circular***

**Alger Supply Company**
**Peoples Gas Bldg., Chicago**

# WALLOON WELDING WIRE

Flows at a low temperature, makes a strong, homogeneous weld, is free from bubbles and other impurities.

## APEX STEEL CORPORATION

50 Church Street, New York

5651 Broadway, Cleveland, Ohio

# WILLIS WELDERS

OXY-ACETYLENE APPARATUS

MANUFACTURERS

of

Welding and Cutting Apparatus, Acetylene Generators, Lead Burning, Platinum Melting and Carbon Cleaning Outfits.

Gas and Oil Preheating Torches and Welding Fluxes, Rods, etc.

*Write for Catalog.*

**Henderson-Willis Welding & Cutting Co.**

**2305-7-9 N. 11th St.**
**St. Louis, Mo.**

Just Off the Press!
A New Book on **AUTOMOBILE WELDING**

**With the OXY-ACETYLENE FLAME By M. Keith Dunham**

*167 Pages* **Price $1.00** *Fully Illustrated*

**This is the only complete book on the "Why" and "How" of Welding**

Explains in a simple manner apparatus to be used, its care, and how to construct necessary shop equipment. Proceeds then to the actual welding of all automobile parts, in a manner understandable by everyone.

Gives principles never to be forgotten. Aluminum, cast iron, steel, copper, brass, bronze and malleable iron are fully treated, as well as a clear explanation of the proper manner to burn the carbon out of the combustion head.

Automobile Owners, Garage and Service Stations, Blacksmiths and Machine Shops, as well, as industries using the oxy-acetylene flame, will find this book of the utmost value, since the perplexing problems arising when metal is heated to a melting point are fully explained and the proper methods to overcome them shown.

CONTENTS

CHAPTER I.—APPARATUS KNOWLEDGE.
Oxygen Supply—Care of Oxygen Cylinder—Acetylene Generation—Care of Generator—Regulators—Care of Regulator — Creeping Regulators — Gauges—Care of Gauges—Welding Torch—Care of Welding Torch—Effects of Heat—Hose and Goggles.

CHAPTER II.—SHOP EQUIPMENT AND INITIAL PROCEDURE.
Preheating Agencies—Welding Table—Location of Welding Outfit—Starting the Welding Outfit—Adjustment of Flame—Principle of Welding—General Welding Knowledge—Welding Rods and Fluxes—Choice of Tip—Expansion and Contraction.

CHAPTER III.—CAST IRON.
Simple Welding—How to Hold the Flame—Hard Cast Iron—Pin Holes and Blow Holes—Lug on Cylinder—Water Outlet—Cylinder Welding—Compression Head—Finishing and Testing—Scored Cylinders—Cylinder Parts—Fly Wheels—Pistons—Crank Cases — Babbitted Bearings — Valve Guides—Preserving Threads—Conclusion of Cast Iron.

CHAPTER IV.—ALUMINUM.
Use of—Welding Knowledge—Puddle System—Flux System—Comparison of Systems—Welding Rod—Preparation of the Weld—Inlet Manifold—Arm of Crank Case—Welding the Arm Without Taking Out the Motor—Break in the Body of Case—Welding Cold —Wrong Method of Setting Up—Lug or Boss Welding—Preheating the Case —Gas Preheating Flame—One Side or Both—Collapse of Weld—Broken Bearings—Direction of Welding—Shrinkage Cracks—Missing Parts—Finishing—Die Moulded Castings—Body—Other Parts.

CHAPTER V.—STEEL.
Welding Knowledge—What the Flame Does to Steel—The Welding Rod—Simple Welding—Position of Flame—Reinforcing the Weld—Frame Welding—Lengthening the Chassis—Tube Housings—Worn Parts—Gear Welding — Case Hardening — Light Metal Welding—Gasoline Tank—Welding Adjacent to Rivets—Shaft Welding—Construction of Parts.

CHAPTER VI.—MALLEABLE IRON, COPPER, BRASS, BRONZE.
How to Detect Malleable Iron—Brazing Malleable Iron—Rear Housing—Reinforcing the Braze—Brazing Tube to Housing—Building Up Worn Parts—Copper—Brass and Bronze—Silver Soldering.

CHAPTER VII.—CARBON BURNING AND OTHER USES OF OXYGEN AND ACETYLENE.
Principle of Carbon Burning—Method of Operation—Lead Burning—Soldering—Case Hardening—Heating Uses.

CHAPTER VIII.—HOW TO FIGURE COST OF WELDING.
Oxygen Consumption—Dissolved Acetylene Consumption—Torch Consumption Test—Acetylene Generator Consumption—Cost Card—Conclusion.

Sent to any address postpaid on receipt of $1.00 **THE WELDING ENGINEER** 608 So. Dearborn St. CHICAGO, ILLINOIS

## No. 2 FIDELITY WELDING OUTFIT

The most complete outfit for cutting, welding and carbon burning. Will handle practically any work of this nature. Packed in a handsome wooden carrying case, complete with a large assorted stock of welding material.

The outfit consists of:
1 No. 2 Welding Torch (22 in. long) with 10 copper tips.
1 No. 2 Oxygen Long Arm High Pressure Regulating Valve, nickeled throughout, with 3,000-lb. tank and 150-lb. working gauge.
1 No. 2 Acetylene Long Arm High Pressure Regulating Valve, with a 300-lb. tank and 50-lb. working gauge.
1 Heavy Nickle Plated Wrench.
1 Pair Olive Green Gelder's Goggles with gauze face protector.
20 ft. High Pressure Hose with clamps.
Large assortment of cast iron welding rod, brass rod, aluminum rod, low carbon rod, Norway iron rod, manganese bronze rod, cast copper rod, also brass and copper flux, and aluminum flux.
All packed in handsome Wooden Carrying Case, with Instruction Book.

## Welding Apparatus for Jobbers

No. 2 Fidelity Outfit

Ask your nearest Automobile Supply Jobber

There is a Fidelity outfit for every kind of welding, cutting, carbon burning, brazing or soldering. We specailize in complete apparatus for the jobber only.

**Torches—Regulators—Trucks**
*and Supplies of All Kinds*

Fidelity apparatus is made of the very finest materials, under most careful and painstaking supervision. Thousands of our torches are being used successfully in all parts of the United States.

Write for illustrated catalog.

**FIDELITY BRASS MANUFACTURING CO.**
1809 W. Washington Blvd. Chicago, Ill.

# Electric Welding Saves Locomotive Shop Nearly $8000 in Six Months

*Read this*

"The application of the electric arc welding process to the repair work in locomotive shops and engine houses is a profitable proposition for the railroad." *Report of Electric Welding Committee, Association of Railway Electrical Engineers.*

According to the above report in one month a locomotive shop saved nearly $1400 by electric welding methods and in six months nearly $8000. Four hundred and eighty-seven operations were performed in one month on 34 different kinds of jobs.

G-E Arc Welding Outfits, which assure maximum economy and convenience in this work, are in use all over the world. A constant stream of repeat orders indicate splendid operating records.

You are invited to get in touch with our nearest office for complete information.

This trade-mark the guarantee of excellence on Goods Electrical

ADDRESS NEAREST OFFICE

Atlanta, Ga.
Baltimore, Md.
Birmingham, Ala.
Boston, Mass.
Buffalo, N. Y.
Butte, Mont.
Charleston, W. Va.
Charlotte, N. C.
Chattanooga, Tenn.
Chicago, Ill.
Cincinnati, Ohio
Cleveland, Ohio
Columbus, Ohio
Dayton, Ohio
Denver, Colo.
Des Moines, Iowa
Duluth, Minn.
Elmira, N. Y.
Erie, Pa.
Fort Wayne, Ind.
Hartford, Conn.
Indianapolis, Ind.
Jacksonville, Fla.
Joplin, Mo.
Kansas City, Mo.
Knoxville, Tenn.
Los Angeles, Cal.
Louisville, Ky.
Memphis, Tenn.
Milwaukee, Wis.
Minneapolis, Minn.
Nashville, Tenn.
New Haven, Conn.
New Orleans, La.
New York, N. Y.
Niagara Falls, N. Y.
Omaha, Neb.
Philadelphia, Pa.
Pittsburgh, Pa.
Portland, Ore.
Providence, R. I.
Richmond, Va.
Rochester, N. Y.
St. Louis, Mo.
Salt Lake City, Utah
San Francisco, Cal.
Schenectady, N.Y.
Seattle, Wash.
Spokane, Wash.
Springfield, Mass.
Syracuse, N. Y.
Toledo, Ohio
Washington, D. C.
Youngstown, Ohio

For Michigan business refer to General Electric Company of Michigan, Detroit, Mich.

For Texas, Oklahoma and Arizona business refer to Southwest General Electric Company (formerly Hobson Electric Co.), Dallas, El Paso, Houston and Oklahoma City.

For Canadian business refer to Canadian General Electric Company, Ltd., Toronto, Ont.

General Foreign Sales Offices, Schenectady, N. Y.; 30 Church St., New York City; 83 Cannon St., London, E. C., England.

# General Electric Company

General Office: Schenectady, N. Y.

6860

No. 8-G for Natural Gas, $5.50

# Preheating Blowpipes

The two most essential points in welding are:

FIRST: The use of a proper sized oxy-acetylene flame.

SECOND: The saving of gas by preheating your work for the oxy-acetylene flame.

The first is under your control in the use of the oxy-acetylene apparatus you have selected.

The second, we can aid you in by supplying the proper blowpipe for preheating purposes.

We manufacture blowpipes for use with Coal Gas, Natural Gas, Gasoline Gas and Acetylene Gas, with Air Blast.

Our catalog "B. X.," free for the asking, contains full description and prices. WANT ONE?

**Buffalo Dental Manufacturing Co.**
**Buffalo, N. Y., U. S. A.**

# You'll Never Be Sorry You Bought the Vulcan

There is great value in knowing that your equipment is equal to any demands your work will make upon it.

## The Vulcan Oxy-Acetylene Welding and Cutting Outfit

is dependable—it will deliver the service as you want it, whenever you want it. Every comparative test will prove it is the best.

Write for Catalog W-1

**Vulcan Process Co.**
2445 University Ave., South East
Minneapolis, Minn.

# ASK ANY LARGE IRON AND STEEL CO.

CARBO-HYDROGEN has proven to be an exceptional cutting medium in the largest iron and steel mills in the United States.

The art of cutting not only consists in being able to sever two pieces of steel, but also to show a minimum amount of slag and unchanged metal at the edges cut and smooth surfaces after the cut is made.

CARBO-HYDROGEN will cut from the lightest to the heaviest metals, and by this we mean to the heaviest armor plate made, with the result that in each and every instance true cuts are made with a rapidity that is astonishing, and with marked economy.

CARBO-HYDROGEN burns with a clean flame and gives off no noxious fumes, and can be readily used in all confined places. It is a true combustible in every sense of the word and in nowise explosive, and, undoubtedly, is the safest gas to use.

CARBO-HYDROGEN is superior to use on all classes of cutting, cast iron welding, aluminum welding and brass welding. In welding, an utter absence of blowholes is noted and the welds are left soft and nice so that they can be readily machined. This is a large advantage where welds must be machined after being made.

CARBO-EQUIPMENT has been designed along scientific lines and no guess-work has been used in any portion of the apparatus put out.

CARBO REGULATORS are undoubtedly the most correct and dependable on the market.

CARBO HOSE will stand the greatest pressure with the longest life.

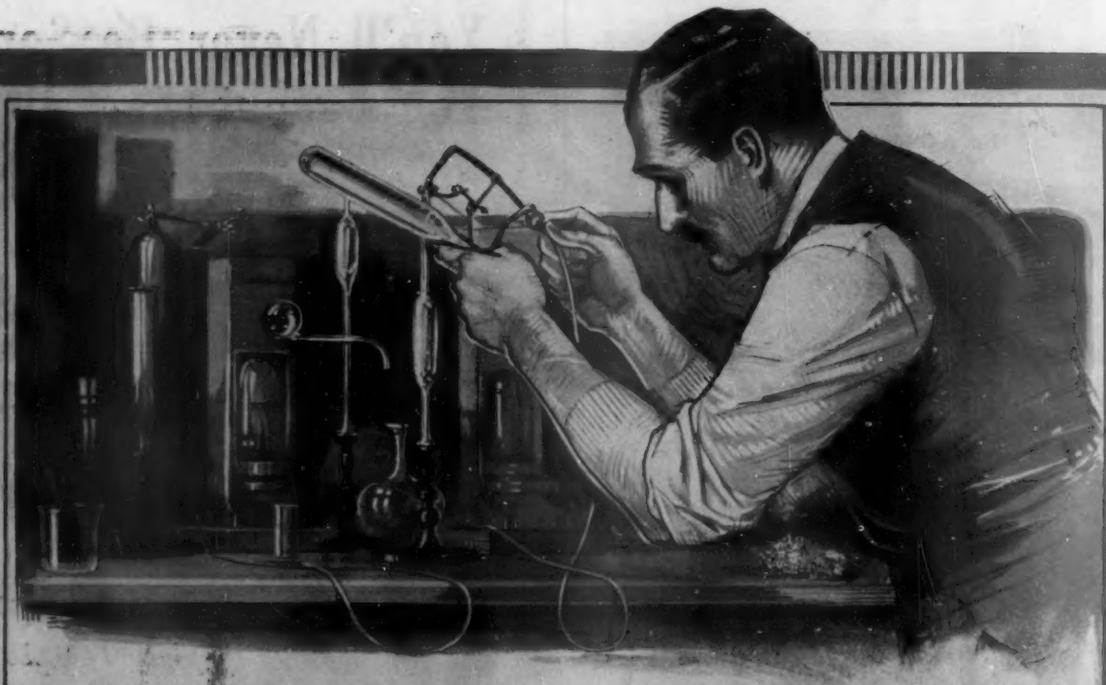
CARBO CUTTING AND WELDING PIPES are scientifically correct in every detail, with the theory of combustion taken care of perfectly.

**CARBO-HYDROGEN COMPANY**
**OF AMERICA**

SOLE MANUFACTURERS OF
CARBO-HYDROGEN AND CARBO EQUIPMENT

GENERAL OFFICES:
BENEDUM-TREES BUILDING
PITTSBURGH, PA.

CARBO-HYDROGEN, Reg. U. S. Pat. Off.
CARBO, Reg. U. S. Pat. Off.

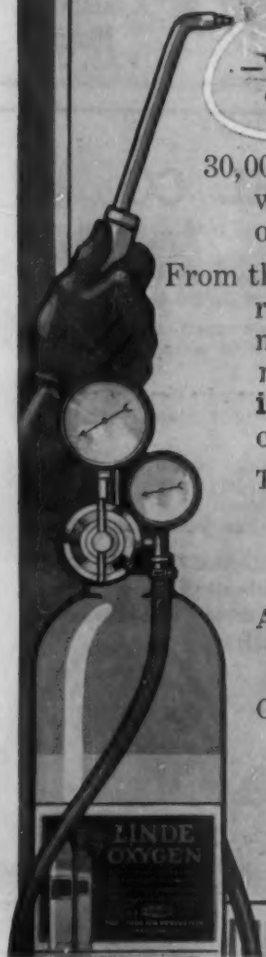


Abnormal Business Conditions
What We Are Doing to Meet Them

Chapter J

**Making Approximately 30,000 Purity Tests Per Month**

**—This to insure uniformity in the quality of the oxygen output from twenty manufacturing plants.**




30,000 tests per month—means over 1,000 tests per day; work which requires the constant attention of one large group of **Linde** chemists.

From the very start of our "abnormal business" problems, we have realized the importance of keeping our purity-testing equipment and staff far ahead of our rapidly growing output and maintaining constantly not only high purity but a **uniformity of product,** which is a determining factor in the oxy-acetylene process.

The thoroughness of the work of this group in the **Linde** organization enables us to anticipate promptly and eliminate the possibility of below-standard oxygen finding its way into any **Linde** cylinder—as any such oxygen is promptly discharged into the air, regardless of the press of daily orders.

As a result, every **Linde** customer is assured of a product of high purity, the slight impurity found consisting of other elements of the air.

Our next chapter in this series will record interesting facts about valve tests in the **Linde** plants—tests which will aggregate over 5,000,000 per year.

**The Linde Air Products Company**
**42nd Street Building, New York City, N. Y.**
*"Largest Producers of Oxygen in the World"*

# WELDING LOCOMOTIVE BOILER FLUES TO FLUE SHEET

*An Account of a Series of Interesting Experiments in The Shops of The Michigan Central R. R.*

*By* B. Kopferschmidt

LOCOMOTIVE boiler flues are made of pure charcoal iron and lap-welded with a machine of special design. Flues are measured by their outside diameter and are usually true to gauge, so that holes for them may be bored without taking measurements from the flues themselves.

The proper method of making holes in the flue sheet is to punch or drill a small hole at a point marking the center of the flue hole. Then use a drill with a post in the center, which fits the small hole, and which drills a hole of the desired size.

Flues at present are fastened to the flue sheet by a mechanical process, which consists of expanding the metal of the flue against the flue sheet. This is done by means of a roller expander. This tool has a set of rolls that are forced against the inside of the tube, by driving in a tapered pin. The pin and the rolls rotate as the pin is driven and the rolls gradually expand the flue against the flue sheet. After the ends are expanded the ends are beaded over the flue sheet, to strengthen the connection between the flue and the flue sheet. Copper ferrules are also placed at the ends of the flues, between flue and flue sheet, to make a steam tight joint.

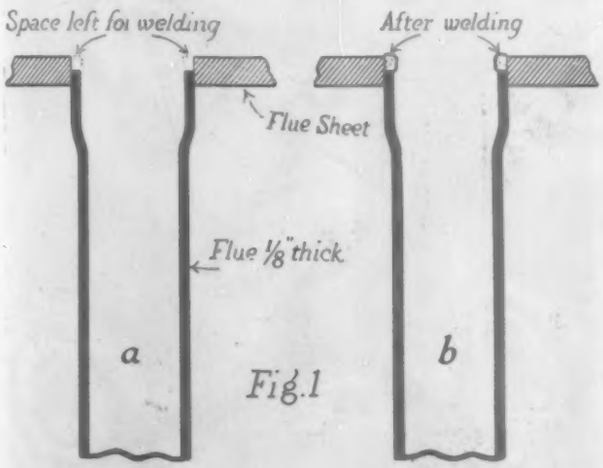


Fig.1

In the past some welders tried to weld flues to the rear flue sheet with an oxy-acetylene torch, and in most cases they have failed. I will not discuss the merits or defects of other welding methods employed at present, but I will state that the oxy-acetylene method for welding flues, although a little more expensive, is going to become the standard method of welding flues, where a reliable and soft weld is desired. This, of course, is based on the work being done by a welder who understands boiler construction.

In order to appreciate my method, it is well to give a brief study to the unsuccessful methods that were tried in the past, by myself and others. The failures were due to two causes: First, the warping of the flue sheet; second, the cracking of the bridges between flues.

The warping of the flue sheet was principally blamed to the intense heat produced by the oxy-acetylene flame and directed to the face of the flue sheet during the welding process. But anyone familiar with boiler work has observed warped flue sheets that were never welded. What is the cause of warping? I mentioned above the mechanical process of fastening the flues by an expanding roller. When the rollers are forced against the flue and sheet, every flue hole is expanding to a certain extent. Considering that some boilers have about 265 flues, this expansion will run to inches stretched out toward the boiler shell. If no heat follows, this expansion will somehow work out in the iron without warping, considering the good properties of boiler steel metal. But if an attempt is made to weld, as soon as the metal is heated the strain left by the rollers in expanding the flues to flue sheet will give way by warping toward the fire box. Therefore, to make oxy-acetylene flue welding successful, the mechanical expansion process and the direct flame to the face of the flue sheet must be eliminated.

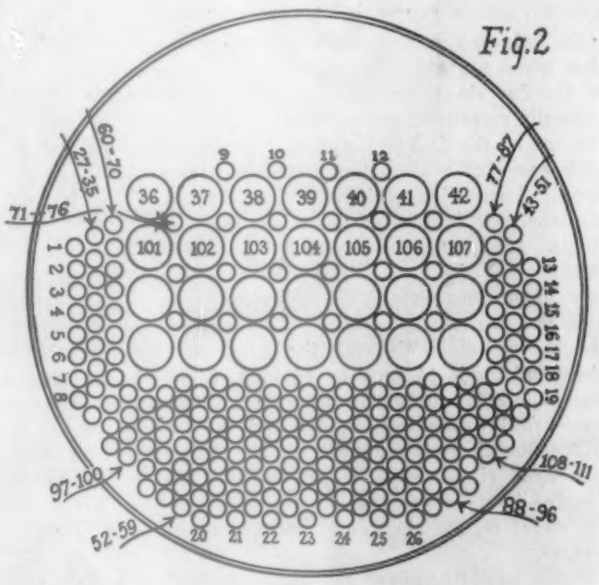


Fig.2

The cracking of the bridges is due to some extent to the strains left by the rollers, yet the principal cause is the

directing of the flame on the face of the flue sheet for welding. Another cause is the contraction. Therefore, in removing the above defects, there is no reason why oxy-acetylene flue welding should not be a success.

The writer, although he has had some welded flues in small boilers in service only four months, believes it is the real practical flue welding process.

### Method of Welding.

Place the flues in the sheet medium tight, with the aid of the roller, so the flue will not turn by hand. The end of the flue should be below the surface of the sheet about ⅛ inch (or the thickness of the flue), as per A in Fig 1. The front end of the flue should be loose during the entire welding operation. Thus there will be left a space of ⅛ inch square between the end of flue and the outside surface of the flue sheet. This space will serve as a bevel and has to be welded to flue sheet, and when completed the ⅛ inch opening will be filled out with metal, and continue the length of the flue, even with the outside surface of the flue sheet as per B in Fig 1. Thus when all the flues are welded the outside surface of the sheet is level without any lumps or welding material. However, when starting to weld a flue one may begin at any spot and continue so for half the hole. Then he must start where he began to weld and thus complete the other half hole.

In welding the ⅛ inch square space the operator must confine his flame to the sharp edge of the hole, as it will be unnecessary to heat the face of the sheet as it is away from the weld. The sharp edge of the flue sheet will melt quicker than the face of the sheet will melt. Therefore, the operator should not use the same size blowpipe or welding head as for ordinary fire box work. It should be smaller, and in proportion to the thickness of the flue.

In following my methods exactly, the operator will find that when he brings the flame of the blowpipe to the edge of the flue sheet, until the extremity of the small white jet licks the metal and produces melting for about ⅛ inch deep, the end of the flue will also melt at the same time and unite with some of the molten metal from the edge of the flue sheet. Then with a ⅛ inch pure Norway iron welding rod the operator builds up the edge, until it attains a square shape. It is not necessary to build any more metal than the thickness of the flue, nor to go any deeper in the flue hole. One must remember that the weld cannot be any stronger than the thickness of the flue, which is ⅛ inch. If the flue should be welded through the whole thickness of the flue sheet, which is ½ inch or ⅝ inch, it will be no stronger than if welded only the thickness of the flue. Thus the mechanical expanding process and the heating of the face of the flue sheet is eliminated. The heating is done around the edged circle only, and the surplus heat is lost through the flue. Of course the sheet gets some heat, but without any effect on the sheet, and there is no warping or cracked bridges.

For a new flue sheet the above method is sufficient, but on an old sheet, where the metal may be crystallized, or under strain due to expanding the flues, it is necessary to prepare the sheet and flues, so as to avoid warping or cracked bridges.

The best method is to place in every flue a piece of cotton waste, about 6 inches deep from the surface of the rear flue sheet. Then fill the hole with dry sand, about 2 inches below the surface. On top of the sand, place a round piece of sheet asbestos, to fit in the inside of the flue, and another piece of wet sheet asbestos to be placed on the flue sheet between the bridges. When the weld is finished one may use the two pieces of asbestos over again, but the sand should be left in the flues until the whole job is completed and cooled.

A good method in welding a set of flues so as to distribute the heat uniformly, is shown in Fig. 2. Thus one may weld the left row between 1 and 8 inclusive. Then start above from 9 to 12, then again on the right row from 13 to 19, then below from 20 to 26, and thus follow, row by row, until the middle flue at A is reached. This flue should not be welded until the flue sheet is reasonably cool. The operator may find this last flue hole out of round. In this case the flue may be hammered to fit the hole and then welded.

The cost is not very high, considering the saving of the boilermaker's labor and of the copper ferrules that are eliminated with this process.

I have not yet decided on an efficient method to cut them out after the limit of service is reached. However, I believe that in this case the cutting will be cheaper then any other welded method. A regular pneumatic flue wheel cutter should cut them below the flue sheet and the ⅛ inch soft metal from the weld, can be easily reamed off.

*Editor's Note:*

*Since the foregoing article was written, Mr. Kopferschmidt's method of welding locomotive flues has undergone a severe test. The test consisted of welding a 2-inch flue to a ½-inch plate, about 10 in. square. The plate was placed in a vise and a leather belt running from an overhead pulley was attached to the end of the flue, the belt revolving around same. This test continued for 17½ hours, when the flue broke at the end of plate. The weld was not injured. It has been suggested that after flues are welded they be rerolled in the flue sheet, thus eliminating any space between flue sheet and flue. It is also suggested that depth of weld be increased from ⅛ inch to 5/16 inch.—Editor.*

---

**In English Mnuition Factories Girls Are Using Oxy-Acetylene Welding Outfits.**

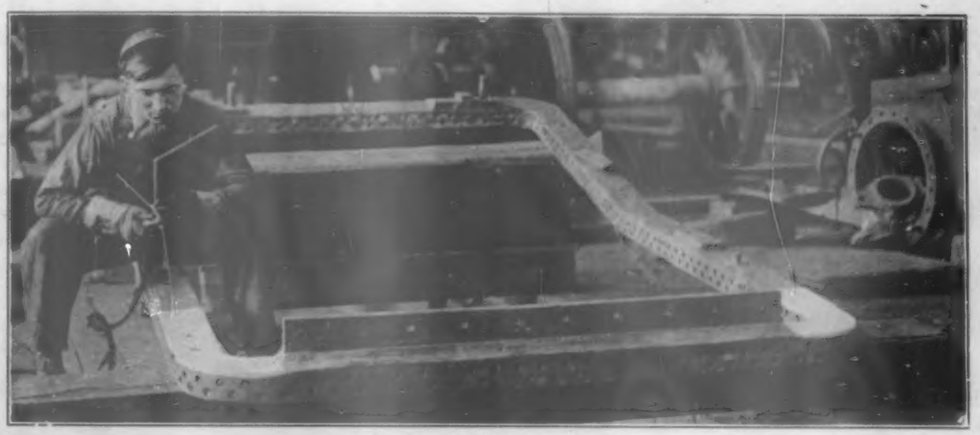
### Labor Saving Tools.

Every welding shop, to be efficient, should be equipped with grinding machines and chippers. Don't depend upon velocity of welding flame to penetrate to bottom of break. Proper preparation insures a good weld. A workman is known by his tools —how about your's.?

# A FEW APPLICATIONS *for* ARC WELDING

## *The Utility and Adaptability of Electric Arc Welding System is Being Recognized. System Efficient and Cheap*

The field of application for electric arc welding is an extremely broad one. Practically every industry making use of iron and steel can utilize this process to distinct advantage. In the manufacture of electrical machines it is largely used for repairing broken and defective steel castings, and in one instance it is used in connection with the regular manufacture of modern motor frames. In foundries and machine shops many applications may be found, the principal one of which is probably that of cutting off risers on castings. In steel mills electric arc welding is used advantageously for many purposes, including: The repair of wobblers and pinions which have become badly worn, building up chipped rolls, and building up broken or worn teeth in gears and pinions. Blast furnaces, which are adjuncts to steel mills, present a very interesting application for this process of welding. Here it is used, among other things, for the burning out of frozen tap holes.



Fitting a New Ring.

Street railway systems are using the electric arc process of welding for many purposes, including the repairing of broken motor frames, brake rigging, worn rails, and in fact, all steel parts subject to wear. Industrial plants employing a large number of machines are often able to reduce their maintenance expense considerably by the use of the process. Repairs to be taken care of in such shops include, broken shafts, worn keyways, building up of rubbed parts, broken gear teeth, and worn rolls.

Another extremely profitable use for electric arc welding is in the welding of tool steel tips to machine tool shanks. The constantly increasing price of high speed tool steel now makes it almost prohibitive for the average shop to use cutting tools composed wholly of such materials. Furthermore, it would be very costly for a shop to have to scrap worn out tools. By electric arc welding these worn tools can be cut to proper size and utilized for tips at a great saving.

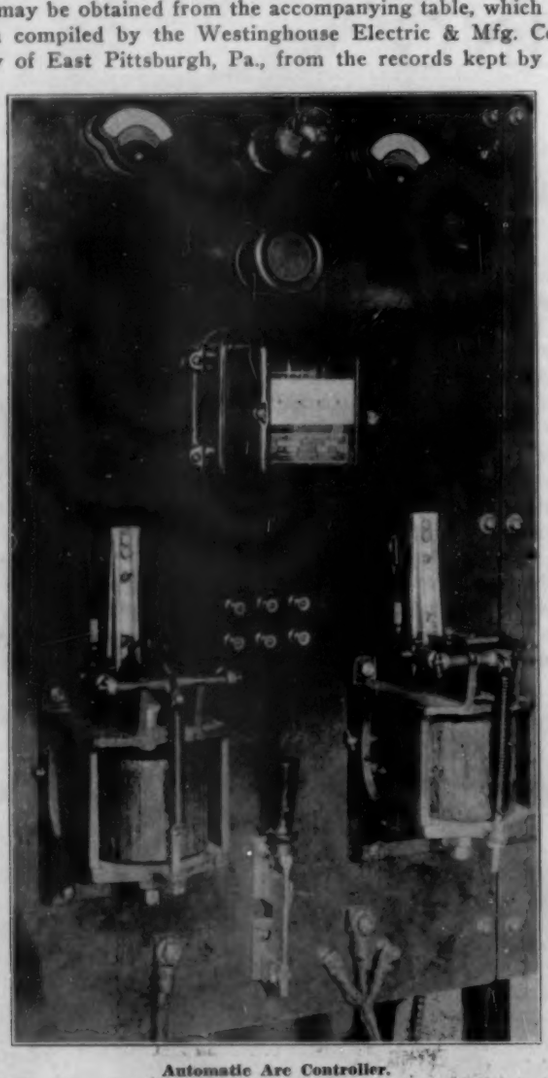
A further use for electric arc welding, which is of comparatively recent origin is in connection with the repair and salvaging of vessels, and the repair of marine boilers. This is accomplished by means of barges equipped with electric arc welding sets, and the work is done without it being necessary for the vessel to put in for repairs. The barge draws up alongside the vessel and the repairs are made while the boat is discharging or taking on cargo, without interruption or loss of time.

Probably the most extensive use for electric arc welding, however, is in steam railroad repair shops. All steam locomotives are subject to rapid deterioration, many parts requiring frequent repair or replacement. Not infrequently, the frame of a locomotive will break in service. By older methods it would be necessary to entirely dismantle the locomotive, sending the frame to the blacksmith shop for repair. This is expensive and in addition means the withdrawal of the locomotive from service. With the electric arc process of welding, such breaks may be repaired at minimum expense without making it necessary to dismantle the locomotive.

The welding of flues in locomotive boilers is probably the most profitable of all applications in repair shops. Prior to the introduction of electric arc welding, the flues were inserted in the fire box tube sheet, the end of the tube being allowed to extend beyond the sheet a sufficient distance so that it could be expanded, rolled and beaded. The tube was also expanded slightly just inside the sheet. Experience has shown that these tubes can be welded to the flue sheet by the electric arc process with best results.

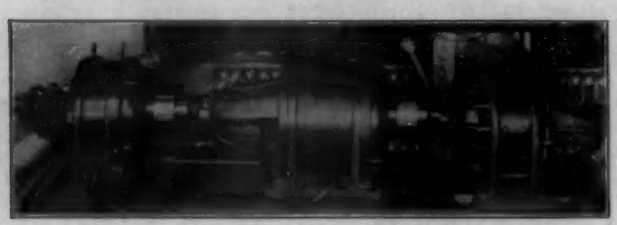
There are other applications in such shops, such as filling holes in driving box cellars, welding spokes of driving wheels, repairing cracks in sides and door sheets of fire boxes, welding bridges in tube sheets, welding guide yokes, repairing mud rings, and other parts too numerous to mention. A large number of railroads have adopted this process and are obtaining very satisfactory results at minimum expense. For example: In one instance, by the electric arc process, repairs were made in a locomotive fire box at a cost of

$134.89, whereas the expenditure would have been $869.58 if former methods had been used. Some idea of the great savings that may be effected by the use of electric arc welding may be obtained from the accompanying table, which has been compiled by the Westinghouse Electric & Mfg. Company of East Pittsburgh, Pa., from the records kept by the



Automatic Arc Controller.

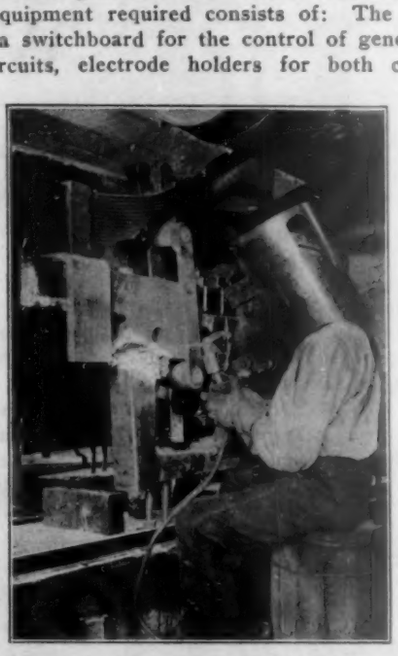
shop using the Westinghouse company's equipments, and represent cases met with in daily work. The shop in question is one maintained by a large railroad. Similar savings are being effected daily in other industries, but as the railroad



Self-regulating Welding Generator.

companies, due to the large amount of repair work they handle, must necessarily keep the most accurate records of repairs made, such a case is taken as typical of the results that may be accomplished by electric arc welding.

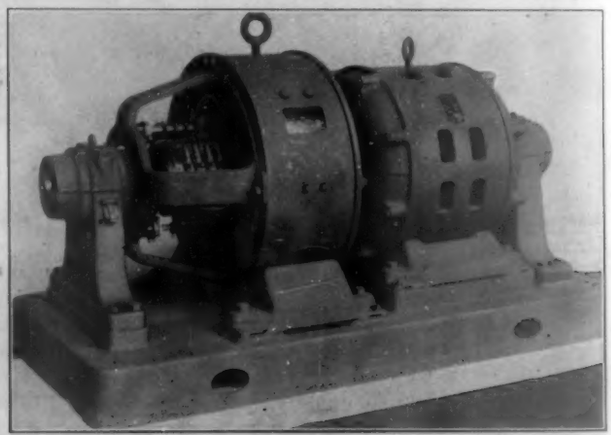
Electric arc welding is inherently a low voltage application. As a rule of source of supply is used having a voltage of from 60 to 75 volts direct current, and resistance is inserted in the circuit so that 30 to 50 volts is impressed across the electrode, as the arc is most stable at that voltage. As low voltage direct current is not always available, it is necessary in the majority of cases to install suitable generating equipment, consisting of either a d.c. to d.c. or an a.c. to d.c. motor generator set. Under such conditions the complete equipment required consists of: The generating apparatus, a switchboard for the control of generating and welding circuits, electrode holders for both carbon and



Repairing Locomotive Frame.

metallic electrodes, protective hoods or masks for operators, and welding materials such as spare metallic and carbon electrodes, flux and filling materials.

For convenience, the process of arc welding may be divided into three distinct parts—preparation of the work, striking of the arc, and the manipulation of electrode, filling materials, and the article or articles to be welded. There are two methods of welding by the electric arc process—the metallic electrode and the carbon electrode. If the weld to be made is of considerable size and if strength is not of paramount importance, the carbon electrode method will



600 Ampere, 230 Volt Westinghouse Electric-Welding Motor Generator Set.

produce satisfactory results in less time than required for the metallic electrode method. The carbon electrode is always used for cutting.

If the ultimate strength of the finished weld is important, the metallic electrode should be used. It should also be employed if it is essential to have the heating of the work localized and restricted to a small area. Further, small welds can be executed better with the metallic electrode.

## REFRIGERATING ENGINEER CONDEMNS PRESSURE VESSEL WELDING

*Frank L. Fairbanks takes the author of the "Straight Talk" article to task.*

*The author of the article following is the Chief Engineer of the Quincy Cold Market and Storage Company of Boston. Its careful reading by welding interests is a matter of importance. Mr. Fairbanks' closing paragraph, urging co-operation and education, is in line with Mr. Dunham's continued efforts to get oxy-acetylene interests together for the same purpose.*

*The importance of the welding industry organizing for the purpose of educating welders and engineers of manufacturing plants is, it seems to us, particularly emphasized in Mr. Fairbanks' article, and while he and Mr. Dunham may disagree on some details, a careful reading of both articles will find them in accord on this one point.*—EDITOR.

Editor:—

I have just received a sample copy of the "Welding Engineer" and I have noted a number of things therein which interested me greatly, particularly the article entitled, "A Straight Talk with the Oxy-Acetylene Industry," by Mr. Keith Dunham.

He calls attention to the fact that it was his "pleasure last month to listen to an able address by John E. Starr, of New York, before the American Society of Refrigerating Engineers, in the course of which he defended welding," and then goes on to say:

"But while Mr. Starr is favorably disposed toward welding there are many of the members of the Society of Refrigerating Engineers who severely condemn it." "Prominent among these men is Prof. Miller, of the Massachusetts Institute of Technology."

Some time ago, Prof. Miller, acting in conjunction with Mr. Fairbanks, a very well known Refrigerating Engineer, recommended "that oxy-acetylene welding should not be used for tension work except very small diameters, say 4 inches; it is not so much that it cannot be done as it is to know that it is properly done."

"If in the opinion of men as high in the engineering world as these two gentlemen undoubtedly are, welding should not be used on tension work, what a fine chance the oxy-acetylene industry has, in its present state of unpreparedness, of convincing a legislature that welding is not at fault, particularly when this legislature can quote such eminent authorities as Prof. Miller of the Massachusetts Institute of Technology to the contrary."

He says, "Why do engineers, highly trained in their professions, refuse to recognize that oxy-acetylene welding is practical, safe and cheap on tension work, if properly done?" and then goes on to tell from memory a very badly garbled account of what was said at the aforesaid A. S. R. E. meeting by "an elderly gentleman, evidently at the head of some refrigerating construction company," and "another gentleman addressed by the chair as 'professor'." The tone of his recollections being such as to carry the inference that the members of this society were somewhat dense, as well as lacking in knowledge, as to just what constitutes a welded joint.

The elderly gentleman referred to, by the way, is the proprietor of one of the largest boiler, forge and welding shops in the Middle West.

The State of Massachusetts has a scrap pile dedicated to the cause of autogenous welding built up of "samples" which did not stand the test and which were furnished by many different enthusiastic welders who were each positive that their particular weld "could not be told from the solid sheet."

He then goes on to say: "Mark you carefully, this society is composed of engineers and this welding talk is not one whit exaggerated. Do you men in the oxy-acetylene industry wonder why tension work is frowned upon by Prof. Miller when engineers have so failed to grasp the elemental principles as to refuse to recognize the importance of expansion and contraction in welding, the trapping of the oxides in the weld, the adjustment of the flame to a neutral character and the proper preparation of the joint to be welded?"

And further on: "Why wait until some lawyer or farmer who doesn't know steel from cast iron or who wouldn't recognize an oxy-acetylene flame if he met it, draws a bill and has it made into a law, which would absolutely prohibit welding, irrespective of how or when or by whom it is executed?"

Now, Mr. Editor, as I happen to be in the mood to make a reply, and the stenographer is not satisfied with the eight hours' work which she has already done and wants to do more for her daily wage, I hope you can find space for a little difference of opinion.

First of all, speaking of "Prof. Miller acting in conjunction" with this man Fairbanks, I have no recollection of the "very small diameter, say 4 inches" part of the statement, and while I have no authority to speak for Prof. Miller, I do hasten to assure you that he has been informed about "the importance of expansion and contraction in welding, the trapping of the oxides in the weld, the adjustment of the flame to a neutral character, and the proper preparation of the joint to be welded," as well as the details of Molecular Physics which relate to the process of welding, including the qualifying influences of "thermal disturbance in the vicinity of the weld." I speak quite positively of this, inasmuch as I have discussed these subjects with him a number of times, and he has never denied having knowledge of them, in fact he admits it.

In relation to the density and possible antagonism of members of the A. S. R. E. I would suggest that they should average well in intelligence with members of like societies. However, I have myself often noted the great difference in intellect, between the man that agrees with my opinions and the man who does not.

A number of members are heads of large manufacturing plants in which there are welding departments having the best equipment, and doing excellent work, and I think I can safely say that the society as a whole is deeply interested in the success of autogenous welding, especially of pressure vessels, in tension, particularly because of the difficulty in the making and keeping tight of riveted joints subject to higher pressures of refrigerating liquids and gases.

So much for the "ethics" of the case, but this is not what has induced me to work overtime to make reply to Mr. Dunham who says in the same paragraph, on page 34, "We don't want fool legislation," and then, "We all realize that daily some inexperienced welder is tackling a job about which he knows nothing and that the failure of his weld may endanger life."

This is certainly to the point and I agree with both statements heartily, but I submit that while only the most careful and wise legislation should be adopted, hampering the manufacturer as little as possible, after making safety the main feature, a continuation of the conditions as stated, until a serious accident occurs, will do more to produce "fool legislation" than any other means in sight at present.

I have in mind a conversation which I had recently with a manufacturer who does a large amount of welding by the oxy-acetylene process, a goodly proportion of which is pressure vessel work, large and small.

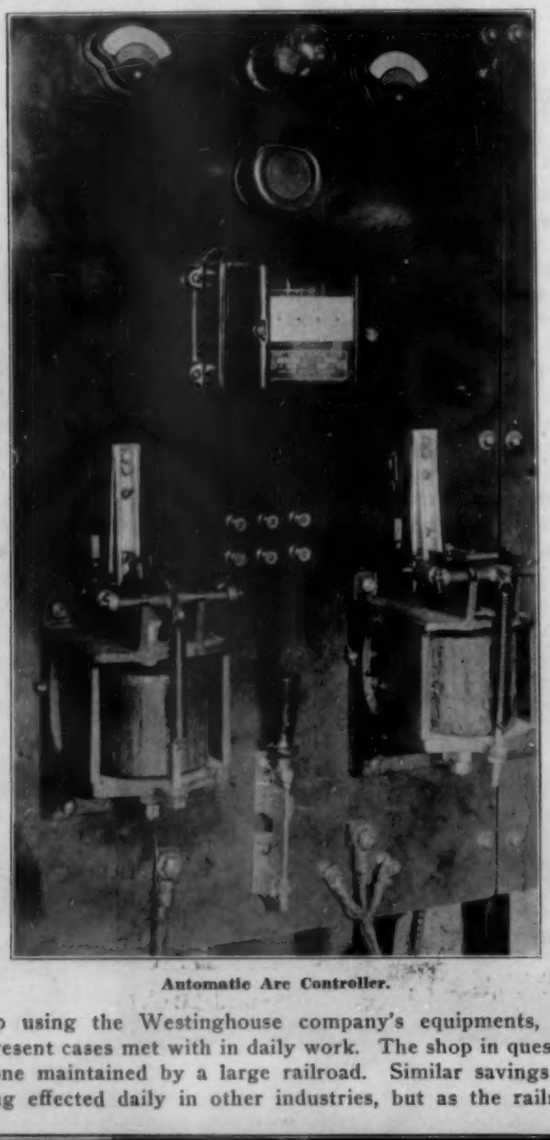
In speaking of labor troubles at his plant he said he found it "very difficult to fill the places of his welders, having tried to break in new men with the result that most of the work so obtained was fit only for the scrap heap."

Every now and then I find myself wondering how much of that work got out to the user and is now subject to high pressure in every day service.

Perhaps you are now beginning to see why welded "tension work is frowned upon by Prof. Miller," acting in conjunction with this man Fairbanks, who, by the way, have not "failed to grasp the elemental principles, etc., etc." It may be that this

(Continued on page 37)

$134.89, whereas the expenditure would have been $869.58 if former methods had been used. Some idea of the great savings that may be effected by the use of electric arc welding may be obtained from the accompanying table, which has been compiled by the Westinghouse Electric & Mfg. Company of East Pittsburgh, Pa., from the records kept by the



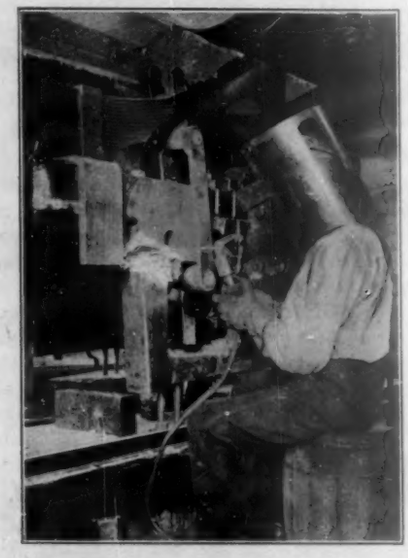
Automatic Arc Controller.

shop using the Westinghouse company's equipments, and represent cases met with in daily work. The shop in question is one maintained by a large railroad. Similar savings are being effected daily in other industries, but as the railroad

Self-regulating Welding Generator.

companies, due to the large amount of repair work they handle, must necessarily keep the most accurate records of repairs made, such a case is taken as typical of the results that may be accomplished by electric arc welding.

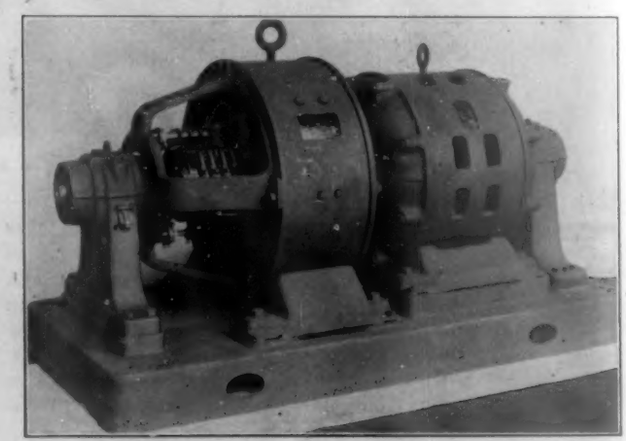
Electric arc welding is inherently a low voltage application. As a rule of source of supply is used having a voltage of from 60 to 75 volts direct current, and resistance is inserted in the circuit so that 30 to 50 volts is impressed across the electrode, as the arc is most stable at that voltage. As low voltage direct current is not always available, it is necessary in the majority of cases to install suitable generating equipment, consisting of either a d.c. to d.c. or an a.c. to d.c. motor generator set. Under such conditions the complete equipment required consists of: The generating apparatus, a switchboard for the control of generating and welding circuits, electrode holders for both carbon and



Repairing Locomotive Frame.

metallic electrodes, protective hoods or masks for operators, and welding materials such as spare metallic and carbon electrodes, flux and filling materials.

For convenience, the process of arc welding may be divided into three distinct parts—preparation of the work, striking of the arc, and the manipulation of electrode, filling materials, and the article or articles to be welded. There are two methods of welding by the electric arc process—the metallic electrode and the carbon electrode. If the weld to be made is of considerable size and if strength is not of paramount importance, the carbon electrode method will



600 Ampere, 220 Volt Westinghouse Electric-Welding Motor Generator Set.

produce satisfactory results in less time than required for the metallic electrode method. The carbon electrode is always used for cutting.

If the ultimate strength of the finished weld is important, the metallic electrode should be used. It should also be employed if it is essential to have the heating of the work localized and restricted to a small area. Further, small welds can be executed better with the metallic electrode.

## REFRIGERATING ENGINEER CONDEMNS PRESSURE VESSEL WELDING

*Frank L. Fairbanks takes the author of the "Straight Talk" article to task.*

*The author of the article following is the Chief Engineer of the Quincy Cold Market and Storage Company of Boston. Its careful reading by welding interests is a matter of importance. Mr. Fairbanks' closing paragraph, urging co-operation and education, is in line with Mr. Dunham's continued efforts to get oxy-acetylene interests together for the same purpose.*

*The importance of the welding industry organizing for the purpose of educating welders and engineers of manufacturing plants is, it seems to us, particularly emphasized in Mr. Fairbanks' article, and while he and Mr. Dunham may disagree on some details, a careful reading of both articles will find them in accord on this one point.*—EDITOR.

Editor:—

I have just received a sample copy of the "Welding Engineer" and I have noted a number of things therein which interested me greatly, particularly the article entitled, "A Straight Talk with the Oxy-Acetylene Industry," by Mr. Keith Dunham.

He calls attention to the fact that it was his "pleasure last month to listen to an able address by John E. Starr, of New York, before the American Society of Refrigerating Engineers, in the course of which he defended welding," and then goes on to say:

"But while Mr. Starr is favorably disposed toward welding there are many of the members of the Society of Refrigerating Engineers who severely condemn it." "Prominent among these men is Prof. Miller, of the Massachusetts Institute of Technology."

Some time ago, Prof. Miller, acting in conjunction with Mr. Fairbanks, a very well known Refrigerating Engineer, recommended "that oxy-acetylene welding should not be used for tension work except very small diameters, say 4 inches; it is not so much that it cannot be done as it is to know that it is properly done."

"If in the opinion of men as high in the engineering world as these two gentlemen undoubtedly are, welding should not be used on tension work, what a fine chance the oxy-acetylene industry has, in its present state of unpreparedness, of convincing a legislature that welding is not at fault, particularly when this legislature can quote such eminent authorities as Prof. Miller of the Massachusetts Institute of Technology to the contrary."

He says, "Why do engineers, highly trained in their professions, refuse to recognize that oxy-acetylene welding is practical, safe and cheap on tension work, if properly done?" and then goes on to tell from memory a very badly garbled account of what was said at the aforesaid A. S. R. E. meeting by "an elderly gentleman, evidently at the head of some refrigerating construction company," and "another gentleman addressed by the chair as 'professor'." The tone of his recollections being such as to carry the inference that the members of this society were somewhat dense, as well as lacking in knowledge, as to just what constitutes a welded joint.

The elderly gentleman referred to, by the way, is the proprietor of one of the largest boiler, forge and welding shops in the Middle West.

The State of Massachusetts has a scrap pile dedicated to the cause of autogenous welding built up of "samples" which did not stand the test and which were furnished by many different enthusiastic welders who were each positive that their particular weld "could not be told from the solid sheet."

He then goes on to say: "Mark you carefully, this society is composed of engineers and this welding talk is not one whit exaggerated. Do you men in the oxy-acetylene industry wonder why tension work is frowned upon by Prof. Miller when engineers have so failed to grasp the elemental principles as to refuse to recognize the importance of expansion and contraction in welding, the trapping of the oxides in the weld, the adjustment of the flame to a neutral character and the proper preparation of the joint to be welded?"

And further on: "Why wait until some lawyer or farmer who doesn't know steel from cast iron or who wouldn't recognize an oxy-acetylene flame if he met it, draws a bill and has it made into a law, which would absolutely prohibit welding, irrespective of how or when or by whom it is executed?"

Now, Mr. Editor, as I happen to be in the mood to make a reply, and the stenographer is not satisfied with the eight hours' work which she has already done and wants to do more for her daily wage, I hope you can find space for a little difference of opinion.

First of all, speaking of "Prof. Miller acting in conjunction" with this man Fairbanks, I have no recollection of the "very small diameter, say 4 inches" part of the statement, and while I have no authority to speak for Prof. Miller, I do hasten to assure you that he has been informed about "the importance of expansion and contraction in welding, the trapping of the oxides in the weld, the adjustment of the flame to a neutral character, and the proper preparation of the joint to be welded," as well as the details of Molecular Physics which relate to the process of welding, including the qualifying influences of "thermal disturbance in the vicinity of the weld." I speak quite positively of this, inasmuch as I have discussed these subjects with him a number of times, and he has never denied having knowledge of them, in fact he admits it.

In relation to the density and possible antagonism of members of the A. S. R. E. I would suggest that they should average well in intelligence with members of like societies. However, I have myself often noted the great difference in intellect, between the man that agrees with my opinions and the man who does not.

A number of members are heads of large manufacturing plants in which there are welding departments having the best equipment, and doing excellent work, and I think I can safely say that the society as a whole is deeply interested in the success of autogenous welding, especially of pressure vessels, in tension, particularly because of the difficulty in the making and keeping tight of riveted joints subject to higher pressures of refrigerating liquids and gases.

So much for the "ethics" of the case, but this is not what has induced me to work overtime to make reply to Mr. Dunham who says in the same paragraph, on page 34, "We don't want fool legislation," and then, "We all realize that daily some inexperienced welder is tackling a job about which he knows nothing and that the failure of his weld may endanger life."

This is certainly to the point and I agree with both statements heartily, but I submit that while only the most careful and wise legislation should be adopted, hampering the manufacturer as little as possible, after making safety the main feature, a continuation of the conditions as stated, until a serious accident occurs, will do more to produce "fool legislation" than any other means in sight at present.

I have in mind a conversation which I had recently with a manufacturer who does a large amount of welding by the oxy-acetylene process, a goodly proportion of which is pressure vessel work, large and small.

In speaking of labor troubles at his plant he said he found it "very difficult to fill the places of his welders, having tried to break in new men with the result that most of the work so obtained was fit only for the scrap heap."

Every now and then I find myself wondering how much of that work got out to the user and is now subject to high pressure in every day service.

Perhaps you are now beginning to see why welded "tension work is frowned upon by Prof. Miller," acting in conjunction with this man Fairbanks, who, by the way, have not "failed to grasp the elemental principles, etc., etc." It may be that this

(Continued on page 37)

# REMINISCENCES *of a* WELDER

## *Each With a Moral—III. That Last Iron Connecting Rod*

CONSIDER the troubles of the repair welder. Not the specialist in the big city job shops who is a cracker jack on aluminum but who doesn't know how steel looks under the flame; nor yet the sheet metal welder each day doing the same class of welding with the same size tip and the same clamps to hold the sheets.

A repair welder must weld all metals. Each job is different than the one before. He may have just finished a small cast iron typewriter part and be about to start on a marine engine lower half of crank case. The casting is perhaps eight or ten feet long, it is quite badly broken and it is one of those many-ribbed cases. It is a dull, lusterless gray in color. Previous experience has taught the repair welder that here is a job to handle carefully if he is to avoid failure. And the job next to be welded is perhaps a piece which looks like a drop forging but which may be cast or malleable.

With his text book at hand and with the experiences of his brother welder in mind as related through his trade paper, the repair welder of today is in a lot happier position than was the repair welder of the earlier days, before text books were printed. But now as then he must have a natural tendency to analyze, to think quickly and to act; and the repair welder, taken by and large, is necessarily a man of considerable judgment, whose acquaintance if you please, is a thing to be cultivated, for his knowledge is great. If he doesn't know something about foundry practice, of boiler making, automobile construction, machine shop work and have a smattering of all things in the metal industry, he isn't a repair welder. He is perforce a man of much learning in all things pertaining to metal and before the great improvements in the construction of automobiles in the last few years, his judgment on quality of cars was to be sought after by the prospective buyer.

He it was who knew that Whiz had a weak chassis; that the differential housing on the Streak was flimsy; that the driving gears in the Four-Flusher, advertised by its makers as nickel steel, was simply soft steel and would not wear over a couple of thousand miles; and that the rear construction on the Cheese had a habit of trying to catch the forward wheels, resulting in the smashing of the drive shaft and the tearing open of the transmission case. These things he learned, not from the catalogues of the manufacturers, but from Old Man Experience in the welding shop, where day by day, come not only the results of carelessness but of weak construction.

Consider therefore the troubles of the repair welder; but in considering them, remember that day by day the repair welder accumulates and stores away information of much value.

Back in 1909, when I had considerable more faith in what I read than I have now but which even then was beginning to be shattered, I thought that a crank shaft, for instance, was always steel. Manufacturers always said it was and I believed what they said. After meeting up with some dozens of broken malleable iron ones in the welding business, I feel like taking an oxy-acetylene torch in my hand and melting a small section of any material before accepting anyone's word as to the character of any particular metal.

A long distance telephone call one morning from a machinery house some hundred miles away anxiously inquired if we could weld in a hurry and guarantee a big connecting rod. Yes, of course we could. If they shipped it that morning, could we by any possible means weld it the same day and get it on that night's express back to them? Possibly. Perhaps we'd have to work overtime and truck it down to the depot but if they were willing to pay for all these things, we thought we'd be able to give them the desired service. At about that time, we would very gladly have agreed to weld the Liberty Bell, or to make the attempt at least if someone agreed to pay us enough to make the gamble worth while. With a parting admonition to be careful to get the proper strength in the weld and urging speed, the party on the other end of the line hung up and along about the middle of the afternoon the awaited connecting rod showed up.

It was about six feet long and until the burlap was unwrapped, we thought we were going to have a good size weld. The break, however, was on the end through which the shaft runs and was perhaps a couple of inches wide and about an inch thick. There was apparently nothing new or novel about this job, so with instructions to the welder to bevel out the break with the cutting torch and weld it up, I stayed in the office and the welder dragged the connecting rod out to the welding room. In the course of ten or fifteen minutes, back came the welder with a puzzled expression on his face and with the information that "there's something queer about that thing, I can't cut it." A brief test with the cutting torch bore out his ideas; the oxygen stream when thrown upon the heated edge had but little effect—it made a slight start apparently and then stopped. Taking a file, we found that the metal was quite soft and then with a hacksaw, we ran down a cut on an angle to the break and with the one cut formed a bevel, the metal coming out in one piece. Then with this piece on the welding table, I melted a small portion of it with the torch and it proved to be cast iron; that is, it proved to be by every means which we knew of determining character of metals, which was the flame.

With a preheating torch playing on the break, we made the weld, using cast iron for the feeding-in rod and after building up the welded section considerable, we allowed it to cool slowly, re-wrapped the connecting rod in the burlap and sent it on its way. Then I began to worry. Great snakes! Supposing that it was some kind of special steel which we had never heard of and that our cast iron weld would let go and break out the cylinder head nad perhaps kill someone. So back to the welding room I went and tackled the small piece which we had sawed out to form the bevel. We welded on some cast iron, sawed it sectionally and found no hard spots and no apparent difference between the metal which had been added from the welding rod and the original metal of the connecting rod. Then I sat down and wrote a long letter, the basis of which was about as follows:

"We shipped the connecting rod to you tonight but want to tell you that we were amazed to find that the metal is cast iron and not a high grade steel, as you advised us. We welded it up with cast iron and reinforced the weld considerably so that now the rod is much stronger in that section than it was originally. Nevertheless we feel that we should

advise you that in our opinion cast iron should not be used for this purpose because of its brittleness. Our usual guarantee holds good, however, in this instance."

Evidently the express delayed the shipment enroute somewhere because the next afternoon back came a three page, single space typewritten letter, written by the manager of the machinery house but sent on its way before they received the connecting rod. Summed up, this letter read about like this:

"We too would be 'amazed to find that the metal is cast iron and not a high grade steel' did we not know how foolish your statement is and did it not show conclusively your lack of metallurgical knowledge. We have been representing the factory which built the engine of which the connecting rod is a part, for over forty years and we know their reputation so well that it is inconceivable that a connecting rod from one of their engines would be anything but the finest steel money could buy. We are very proud of our reputation and theirs and will not allow you to jeopardize it without warning that we will prosecute you for libel. Of course we will not use the connecting rod which you have undoubtedly spoiled but will have the factory send for another one and will know enough in the future not to send you any more business."

To which we replied that we stood pat; that the connecting rod was cast iron and that we didn't give a hurrah whether they gave us any more business or not; that we did not say that this particular rod was the one originally shipped with the engine and that it might have been cast by some user. Furthermore we didn't profess to be metallurgists but that we did know the welding business and that the blamed thing was cast iron and not steel. About every third line of our letter reiterated that the connecting rod was cast iron—you see we weren't quite positive ourselves and probably were encouraging ourselves by saying over and over that we were right.

A couple of days passed and then another letter and—oh! joy! He crawled. Humbly apologizing for his previous letter and saying that only a cursory examination was necessary to determine that we were correct, the machinery house manager stated that the connecting rod was sure enough cast iron and that he was demanding an explanation from the factory.

The moral to this little tale might be the old one of "First be sure you're right; then go ahead." But from the welder's staindpoint the better one it seems to me follows:

*Moral*: *In Determining Character of Metals, You Can't Fool the Oxy-Acetylene Flame.*

Next month: The Man Who Wouldn't Learn.

## JOB WELDING SHOP EXHIBITS AT NEW YORK AUTOMOBILE SHOW

One of the exhibits at the New York Automobile Show last month which attracted considerable attention was that of the Bournonville Welding Company of New York City.

This concern operates one of the largest job welding shops in the East, specializing on automobile repair work. The character of the exhibit was such to attract the attention of the car driver, garage owner and needless to add, the welding man.

Worn or broken parts of the automobile, from the radiator to the rear housing, were shown in "before and after" welding treatment and two representatives were on hand to explain to visitors the object of the exhibit.

In one of the booklets handed out is a phrase which is worth reading by everyone interested in welding. "Anything that is worth welding is worth welding well."

One other sentence which may be of interest to some job welders is as follows: "Crank shafts welded and guaranteed."

C. B. Gale is president and manager of the company which employs about forty men. Shops of this character are doing much toward increasing the use of the oxy-acetylene process because the management is careful to turn out good work with the right kind of a guarantee behind it. Mr. Gale is to be commended for his progressiveness in bringing his job welding shop to the attention of the automobile using public and the oxy-acetylene industry is to be congratulated in having a man of Mr. Gale's ideas as a user of the system.

## EXHIBITS OF WELDING APPARATUS AT NEW YORK AUTO SHOW

Probably for the reason that all automobile repair shops recognize the value of the oxy-acetylene process, there were few exhibits of apparatus manufacturers at the New York Automobile Show. Other than the Prest-O-Lite Company, which can always be counted upon to bring to the attention of the public the uses of oxy-acetylene, the only other exhibitors were the Cox Brass Manufacturing Company of Albany and the Stewart Sales Company of Chicago.

## THE WELDING INDUSTRY

It would be neither correct nor fair to assume that simply getting an oxy-acetylene welding outfit is all the smith needs to make an important addition to his business and profits.

He must first learn to operate it and then let his patrons and the public know that he can mend or cut anything in the line of metals that is likely to require it.

An intelligent workman who has carefully read the instructions sent out by the manufacturer with every outfit sold should be able to do good work after a little practice, together with patience and perseverance.

First let it be understood that this welding must not be confused with soldering or brazing. Acetylene welding is fusing the parts into a solid piece of the same structure and character as the original. Soldering or brazing is simply sticking the broken parts together, as it were, with another metal having adhesive qualities. The mended part is, of course, far weaker than the original. In oxy-acetylene welding the parts may be built up so that they are even stronger than the original if so desired.

The blacksmith who has an idea that the oxy-acetylene welding operation is not the best and most successful method ever devised of mending or cutting broken parts of metal, is indulging in an error. Also, the smith who imagines that he can go ahead haphazard without thought, instruction or practice and do satisfactory work, is bound to be disappointed.

But one thing is sure: The smith who goes into it intelligently and thoughtfully will soon find it a most desirable and profitable part of his business. This is the age of machinery and the age of metals. Farm machinery and household machinery are rapidly increasing in use. Such machinery is bound to get broken and will require mending. When the public learns that the smith can make it as good as new and do it quickly and at little cost, there will be constant call for it to be done.—Blacksmith and Wheelwright.

The building up of worn parts of frames that may be cut by spring hangers and other appliances is coming rapidly into use, as well as the stirrups of driving boxes and other parts subject to excessive pressure and consequent deterioration, may in a short time be made as good as new. Generally speaking, in the complete overhauling of a locomotive, which occurs at intervals of about a year and a half of regular service involving a running of 50,000 or 60,000 miles, a great economy is effected by the use of the electric arc welding process. A new back flue sheet is becoming more and more necessary in recent service, and this important piece of work is greatly facilitated by the use of the electric arc, and in the application of patches, when necessary; almost a double period of service can be got out of the modern locomotive boiler, when it has been so equipped. The advantages secured by this form of welding are only now in the earlier stages and as the field to be covered is wide, one may expect to see numerous improvements.

# The Welding Engineer

Published on the First Thursday of Each Month by

THE WELDING ENGINEER PUBLISHING CO.,
608 S. Dearborn St., Chicago, Ill.
Telephone Wabash 7134.

L. B. Mackenzie.....President and Editor

Subscription payable in advance and postage free.

United States, Canada and Mexico.....$2.00 a year
Foreign Countries ..... 2.50 a year
Single copy, domestic .....20 cents
Single copy, foreign .....25 cents

Entered as second-class matter January 20, 1916, at the postoffice at Chicago, Illinois, under the act of March 3, 1879.

The Welding Engineer is a member of the Audit Bureau of Circulations.

We guarantee that of this issue more than 4,000 copies were printed, excluding copies spoiled in press room and bindery. At the time of mailing the known distribution was (actual count always exceeds press order):

| | |
|---|---|
| Copies to paid subscribers | 2,183 |
| Copies to advertisers | 82 |
| Copies to prospective advertisers | 85 |
| Copies to other trade papers, correspondents, etc. | 61 |
| Copies mailed as samples to prospective subscribers | 1,679 |
| Copies for office use | 10 |
| TOTAL | 4,100 |

VOLUME 2. FEBRUARY, 1917. NUMBER 2.


## Real Co-Operation.

WE have recently said a few things about co-operation, and in our last issue a member of the trade pointed out some very good reasons why the welding industry should pull together. When we speak of co-operation we refer to electrical as well as oxy-acetylene interests. If the boiler people, for instance, believe a welded seam to be dangerous, it is poor business for an electrical man to advance the argument that, while an oxy-acetylene seam may be unsatisfactory, an electrically welded seam can be depended upon. First of all, let's pull for welding, and may the device take the hindmost. An editorial in a recent issue of a national publication illustrates our idea perfectly:

"If a man is selling lead pencils, first of all he wants people to use lead pencils, and in that basic respect his interest is identical with that of his competitors. He ought to be working heartily with them in every legitimate means of promoting the lead-pencil habit.

"The principle applies in many cases where it is not so obvious. Banks generally opposed postal savings, in which they saw nothing but competition with themselves. At present, deposits in postal-savings banks are increasing at the rate of a million dollars a week. At the latest report there were six hundred and sixty thousand depositors in these institutions, with more than a hundred million dollars to their credit.

"Meantime deposits in other savings banks have increased as never before. Far from injuring other savings banks, postal concerns have helped them. They have got some hundreds of thousands of persons into the habit of saving and made them potential bank customers. They have enlarged the common market.

"Savings banks and life insurance companies are in the same general line of trade. Both have something to sell to those who should make provision for the future. Their tendency has been to regard each other somewhat as competitors; but they ought to work heartily together on the sound principle that whatever either of them can do to enlarge the market for their common article—namely, provision for the future—will ultimately benefit both.

"There is a lot of this purblind competition—for example, fratricidal jealousies between railroad and trolley, newspapers and periodical publications, gas and electric light. A pull together to enlarge the common market would be more to the point.

---

## As It Should Be

IT is gratifying to us to note that manufacturers of products employing welding in their construction are recognizing the value of impressing upon their prospective buyers the superiority of welded construction.

It is pleasant to see a filing cabinet manufacturer emphasize that his corners are welded; to find a full page advertisement of window sash telling that oxy-acetylene insures strength and rigidity; that an automobile accessory has no riveted joints but is all welded; and that a fireproofing construction is all one-piece due to its welded joints.

This is as it should be. Welding is coming into its own for some purposes. Thousands of uses are still to come. And the good work is helped along by the publicity which manufacturers are beginning to give welding, as publicity always helps.

---

## Welded Steam Car

ONE of the exhibits at the Automobile Shows around which the crowds congregated was that of the Doble steam car. The construction of the engine of this car was made possible through the proper use of the oxy-acetylene flame, there being hundreds of welds in the boiler.

It is interesting to note that at a meeting of automobile engineers in Cleveland, Mr. Doble, the designer of the car, in answering the questions of engineers, stated that bursting tests of tubes of the boiler showed that at between 8500 and 9000 lbs. pressure per square inch the tubes ruptured at a place remote from the weld. This is an interesting example of tension welding on small diameters and is conclusive evidence that oxy-acetylene welding may be safely used if proper attention is paid to details.

---

## The First Year

THE *WELDING ENGINEER* has concluded the first year of its history. We think we have a right to feel proud of our first year's work. We believe we have demonstrated our usefulness and our capacity to help the welding industry.

It is not our purpose to grasp this opportunity to tell you how many subscribers we have lured into our fold, nor do we intend to tell of the many advertisers we have induced to look kindly upon the dotted line. On the contrary, we wish to express our thanks, in fact, to the many members of the craft who have done so much this first year, to help their fellow welders. The man who has knowledge of welding and who is sufficiently broad-minded and unselfish to impart that knowledge unto others, is an ornament to his profession. There are men we regret to say, who believe in permitting others to go their way, make the mistakes common to all, and profit by experience.

We are doing our utmost to spread the gospel of the efficiency of welding and cutting. Won't you co-operate with us?

---

## Let's Face the Music

WE understand some of the big men in the welding industry have not taken an active interest, or at least an active part, in the deliberations of certain engineering organizations for the reason that they distrust the ability of welders as a class. If this is true it is only one more reason why some central controlling body is necessary. There are good welders. Why can't we put them on record?

# *Hints for the Welder*

*When you finish an interesting piece of work, can you set down on paper the manner in which you went about the job, how you prepared the work and how the job was done? Have you learned some little stunt every welder ought to know? Contributions to this department are paid for. Write it down any old way—I'll polish it up. Make a rough pencil sketch and our draughtsman will fix it up fine. Line drawings are more practical than photographs. Do it today—the men on the firing line are waiting.*

*L. B. Mackenzie, Editor.*

### WELDING CYLINDERS

Editor: In your January paper we note the replies you make to inquiries from Mr. Geo. M. Hamilton and Mr. Wm. Trontners in reference to welding cracked cylinders and we differ with you very muchly. We have been there good and strong and now we have practically no trouble in repairing cracks of this kind permanently and without warping the cylinders. In the early part of our welding we undertook to weld a pair of Buick cylinders, both cracked on the outside. We heated the cylinders, top down, and after working on same four days got the weld to hold, but when the poor fellow got the cylinders they looked more suitable for a pile driver than for an automobile and he then had to return them to us in order to have the pistions fitted. Of course we never get two jobs exactly alike, but the same general principle will apply to all. First, the metal in cooling should always contract against the weld and the parts should always be preheated with this in view. In welding a cylinder you have always got to take care of the warping and it should be *cooled just as heated*. In welding automobile cylinders, or steam cylinders, we place the cylinder's BASE down over a small charcoal fire, so arranged that each cylinder will get about the same amount of heat *in it*, regardless of where the break is, and then cover the whole with asbestos paper so that but little or no heat will escape nor draft hit the cylinders. We gradually increase the heat, taking from two to four hours until the top part of the cylinders are hot enough to fry oil freely but not red. We then turn the cylinders so that the crack is over the fire and again increase the heat until the part to be welded is hotter than the rest of the cylinder, but still not red. Then turn the cylinder over, all the time keeping it well covered all over with asbestos paper, and make the weld. As soon as the weld has been made we replace the weld in the fire, and blow up the fire slowly until the weld has darkened. We then replace the cylinders over the fire as we first started, *base down* and get them as near the original heat as possible which only takes a few minutes. As soon as we have done this we put them on the floor and quickly cover them with an asbestos lined box to cool and the job is done, except to emery off the rough where the weld was made. We have never had a weld crack or a cylinder warp when treated in this way and we have worked them from 2 in. in diameter to 22 in. and from one cylinder to blocks of four. This may not be according to theory but is according to fact. We have tried a little of everything for preheating but the heat from charcoal seems to have an affinity for metal that we have not found in anything else. We find cooling as important as preheating and we use nothing but charcoal for that purpose.

If this letter is not too long and too rambling suppose you print the same in the Engineer. J. W. Gannon,
Southern Welding Co.

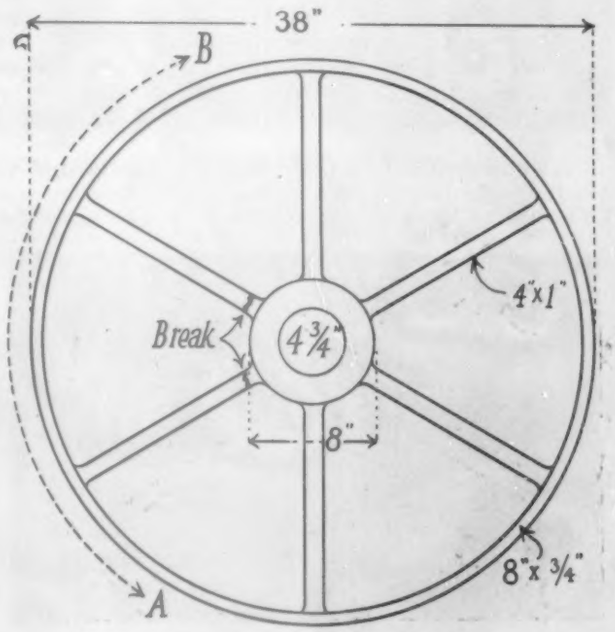
---

### Spoke Welding.

Editor:

Find enclosed a pencil drawing of a cast iron wheel. We wish to know what method to use to do the job as to preheating. The spokes that are marked at hub represent the break. There are no breaks in the rim. The spokes have pulled away from the hub about ⅛ in. S. B. Finegan.

Answer:




This job may be done by preheating the rim in that section marked from A to B. This preheating should be comparatively light, a very dull red being amply sufficient. This will open up the breaks and the welds may then be made, and if necessary the hub at that portion in the vicinity of the break may also be preheated.

Another method of doing this would be to cut the rim in two places, each cut close to the end of each broken spoke, preheating one side of the hub in order to save gas

and to more easily fuse the material, allow to cool, then make the welds in the rim which have been cut.—Editor.

## A BIG FLY WHEEL

Editor: I am enclosing two small photos of a fly wheel which may be of interest. It will give some idea how a job of this description can be repaired out of doors. You will notice the break was through the hub, from the edge of the keyway and, included a piece of a spoke.

I drove four iron stakes in the ground, secured the wheel

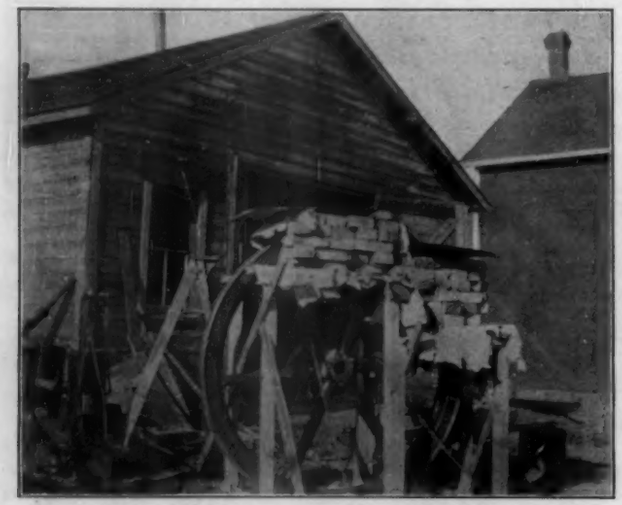


Fig. 1. Method of Preheating Large Flywheel.

by chains, chipped out the fracture, made a temporary platform from 2 x 4 scantlings and built two furnaces on each side of spoke affected. The fracture separated about ¼ in. two hours after furnaces were started, when job was welded. After welding, job was well covered at hub. This wheel has been in operation since (seven months) every day and does fine.

I can't understand how G. A. Raguse is able to weld his wheels by the method he described in the January issue. I keep the spoke as cold as possible to prevent expansion.

Fig. 2. Showing Break in Hub.

Notice in Fig. 2 that there is no fire at spoke. In fact I had wet asbestos at this point.

Would like to pass a remark about grinding plates, mentioned by the Southern Welding Company. I find these are purchased too cheap to weld any more. Also these are to be glass hard to be effective in use; it spoils them to preheat. I have no trouble in welding these. I do them as you suggest only as they are dished. I have plates to fit, but I had to quit, as they are too soft at the weld.—I. Jackson.

## PREHEATING OUTFIT

Editor: Illustration No. 1 shows my preheating outfit with kerosene burners, one directed on brick furnace, built on revolving table. Burner is on swinging arm, movable nearer or farther away from work, while burner support can be raised or lowered on pipe which is welded to the stack. Duplicate burner can be seen at the right, raised up out of the way.

No. 2 is the detail of stack and hood to carry away smoke and gases. Stack is 28 ft. high, 14 in. in diameter; incidentally was made of old gas scrubbers 7 ft. long, welded into one length. The chain pull damper is in the stack to be

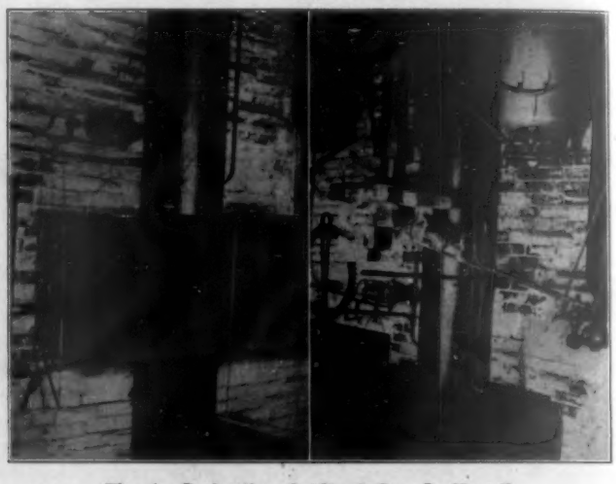


Fig. 1. Preheating Outfit of Geo. L. Howell.

shut when not in use because heating stove pipe is connected to the stack, damper is weighted and will stay open or shut. The support for burners is shown and one burner is folded against the wall out of the way.

The hood just clears my head and the stack rests on the floor, making it unnecessary to build a support for it.

Now all this is very plain to me but I doubt very much if it will be to the readers, but what I am trying to tell is a rig that can be used on a variety of work and can be kept going while the welding is being done, that is you don't have to hurry; if you want to rest just move the burner over on your work and keep it hot; if your glasses get so hot they burn you take a rest. I have had enough work doing some of the jobs with this very convenient outfit and don't understand how some men pull off the stunts they do with a charcoal fire in a small closed room, some people commit suicide by placing a small charcoal fire beside their bed.

Maybe the photos will give some one an idea of my preheating outfit and in some way will help him fix up a more convenient rig. If so, I will feel that I have done some good. The trouble is, welders cannot write and writers cannot weld.

Geo. L. Howell.

## LOCOMOTIVE SUPERHEATER UNITS

Editor: I have been welding Locomotive Superheater Units with such success that I have been asked by one of our foremen to write a few lines in regard to this line of work.

I am not an acetylene welder but thought that some one might profit by my experience.

I notice that some operators have an idea that all that is required is to have a flame on the end of the torch and melt some metal on the end of the unit. It makes no difference what kind of a flame it is, just so long as it melts the metal on the end of the unit.

I have seen units with enough metal on them to weld a

dozen units properly. Some operators have an idea they can reinforce the unit by welding a quantity of metal on it. In this case, I find the unit full of pin-holes due to the non-skilled operator. A quantity of metal on a unit in this manner takes up the air space in the flue and soon burns off and bursts open worse than before.

All operators who have welded Locomotive Superheater Units know that there is an alkali which forms in the end of the unit. I find that the larger the crack in the unit, the more alkali there will be in it.

Few operators remove this alkali before welding, which should by all means be done, as it will cause pin-holes by the dozen, and the unit when being welded will look like a sponge. This alkali can be easily removed by heating the unit, driving a chisel in the crack and with a hook, pull out the chunks of alkali. Then, again heat the unit and close the crack with a small hammer and weld. A tinner hammer I find to be the best for this work.

To weld a unit properly, according to my experience, first remove all cinders and scales from the end of the unit by the use of a small tinner hammer; second, observe the size of the crack, if it is a small one and not gapped open it will be safe to weld as there is little chance of any amount of alkali in the end of the unit. If unit is bursted wide open I most always find a quantity of alkali in it which should be removed before welding. Heat the crack, if gapped open, and close with your hammer and weld the crack. Do not run metal all over the end of the unit, trying to reinforce it, as this will cause the flue to be about stopped up and not allow air space between unit and flue when in service.

The boilermakers are making a cap of charcoal iron which is about 2½ in. in depth by 3/16 in. in thickness. This cap is made to drive on the end of the unit tight when heated. We then weld edge of cap to unit. This makes a smooth job, also reinforces the unit and takes up little of the air space when unit is in its place in the flue.

These caps don't seem to burn off as bad as a quantity of metal melted on end of unit. Be sure you have the proper welding rods for wrought iron welding. Not common wrought iron, as this iron is not prepared for this work. Have your torch burning properly. C. E. Pierson.

## CAST IRON DIFFICULTIES

Editor: I have been welding only about nine months and had only about four days instruction from an experienced operator when beginning. So you see my trouble may seem very simple to an experienced welder.

I welded a center bearing casting for a geared locomotive truck, the metal was about 2 in. thick and the casting weighed about 300 lbs. I had trouble in getting the metal to fuse; in one place especially it seemed to oxidize so fast I could not get it out of the way, a thick crust would form on the surface and a few drops of metal would "sweat" through the crust at a time. I would gouge it out and it would form again before I could fuse the metal. In fact I could never get it to puddle satisfactorily where this oxide formed. The casting was very hard, I noticed, when chipping the bevel.

I finally got it welded but am not satisfied with the job. Please tell me what the cause of the trouble is and how I can overcome it. I have what is considered a good torch and generate my own acetylene gas. I do not think my flux is anything extra but it works pretty well on the average cast iron.—W. A. Bennett.

Answer: Your trouble was evidently due to the fact that your metal was not hot enough in the vicinity of the weld and that the heat was transmitted away from the weld so fast that you could not bring the casting into fusion. This lack of heat may have been because you did not get the casting sufficiently hot with whatever preheating method you used or it may be because the flame you used with the welding torch might have been too small. Metal of this thickness should be preheated to a red heat and held at this heat while the weld is being made, and your flame sould be sufficiently large to form a good sized puddle without bringing the tip of the cone into contact with the material at any time—the end of the cone being held slightly away from the surface.

The foregoing applies if the metal welded was cast iron as you say it is. We are not familiar enough with the construction of the part to definitely advise in this respect, but question the advisability of using cast iron in this instance. You also state that when chipping the bevel the casting was very hard. Are you certain that the metal was cast iron?—Editor.

## WELDING A LOCOMOTIVE FRAME

The locomotive frame shown in the illustration was broken in four places, three on the left and one on the right side. The left side of frame was ⅛ in. short and twisted out of

**Welding Locomotive Frame.**

line. The St. Joseph Welding Company, St. Joseph, Mo., did the work, three welds being 4 x 4 and one 4 x 6. The left side of frame was lengthened ⅛ in. and straightened. Time, 36 hours, two operators. F. R. Wareham is manager.

## ALUMINUM CRANK CASE

Editor: We have an aluminum crank case that showed a crack and leaked oil badly, so we undertook to weld the crack, and by doing so discovered that the crack did not go all the way through the metal. So we started to preheat the case and found it to be all full of little holes or pores. The grease would boil out of them. Please give me an idea of what to do.—F. D. Hammer & Co.

Answer: It is very difficult to advise how to weld anything unless you make a rough pencil drawing of it and show the location of the break.

The fact that this case boils out oil while preheating prevents your making a good weld until this oil is completely removed. You should wash the case in a solution of soda or with gasoline in order to get as much of this oil out as possible. When the break or crack is an old one it is quite common to find porous parts such as you describe and this does not mean that you cannot make a successful weld. Handle the case exactly the same as you would any aluminum break and pull out the old metal with your puddle rod before adding the new material from the welding rod. If this does not give you the information you need, send us a sketch as mentioned above.—Editor.

### LEAD BURNING

Editor: Can you give us any information about lead burning on large 12 x 9 tanks? We have on hand orders to several and I have never had any experience in that line. You might also inform me where I can get the lead burning outfit.—Ryan Welding Co.

Answer: Lead burning is accomplished with either hydrogen or acetylene and most of the apparatus manufacturers catalogue a lead burning torch.

Before you start in on welding the tanks in question, it is essential that you do some practicing to familiarize yourself wth the action of lead under the flame.

The joints in lead burning may be either lapped or butted and depending upon the strength desired, they may be welded or burned with or without a welding rod, which is usually a strip of pure lead. Cleanliness of the line of welding and adjacent section is even of greater importance than with other metals and the surfaces should be scraped or filed bright.—Editor.

### WELDING AN ICE MACHINE WHEEL

The fly wheel shown in illustration was 12 ft. in diameter, spokes being 6 in. thick and 12 inches wide at hub. Hub was 18 in. wide and 5 in. thick outside of spokes. Rim

Welding 12-Ft. Flywheel.

was 9 x 10 in. and solid. The hub was broken clear across through the keyway and up 10 in. on center spoke. The break was 18 x 5 by 10 x 4 in. This job was handled by Manager F. R. Wareham of the St. Joseph Welding Co., St. Joseph, Mo.

### SPOKES IN FLYWHEEL

Editor: I am a reader of your valued paper and as I have a large flywheel to weld two spokes, I thought I would write to find out if the way I would preheat and weld would be correct.

The wheel is four feet high and weighs 1,000 lbs. with a six-inch face two inches thick, and then a solid ring inside of this same thickness as the spokes, which are two inches.

I propose to place two large preheating torches on the rim, one each side of the broken spokes. Would it be best to let the weld cool on one spoke before starting to weld the next? I enclose a sketch showing the location of breaks.

Any information you can give me would be appreciated. Would you use coke and charcoal in connection with your blow torches and heat more of the rim?——C. P. Ashley.

Answer. Your method of handling this is in our opinion approximately correct. We would, however, rather use three instead of two torches, placing the third one on the rim between the two broken spokes. After the weld on one spoke has been completed, shut off the third preheating flame, leaving two on each side of the remaining broken spoke.

It is not necessary to use coke and charcoal in connection with your preheating torches as the rim must not be heated too hot—only hot enough to open the breaks at the spokes a sufficiently wide distance to take care of the contraction of the cooling metal which would be approximately one-quarter of an inch.

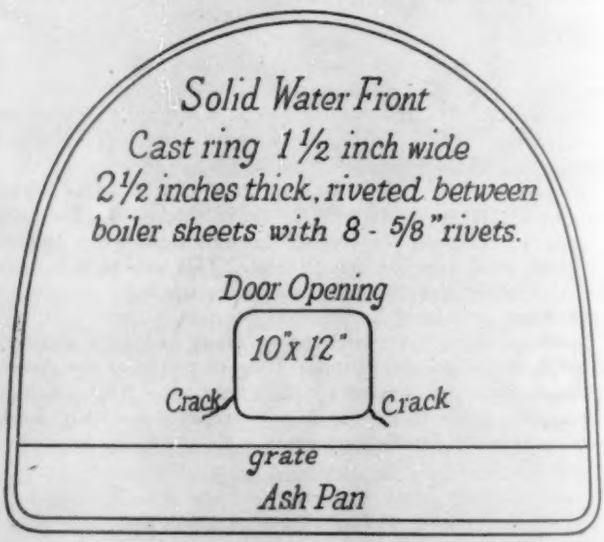
### Boiler Ring.

Editor:

We are enclosing sketch of traction engine with cast iron ring cracked as marked. This ring is riveted between two sheets of boiler steel to make a solid water front, so you see it is impossible to take it out without removing the back of boiler. We preheated ring and welded same, but the boiler would take up so much heat that in contracting the ring would break. We also tried welding without heating but had the same result. Nesshoefer Bros.

Answer:

We do not understand exactly your situation and can answer only in a general way with the hope that some of




our readers will be able to give you more definite information.

We can hardly see any way you can do this job unless you do take out the ring. You will understand that when you make the weld the metal at the weld and for some distance each side of it occupies a larger space than it will when it is cold. As it starts to shrink the rivets each side of the break hold it in place and of course the fact that it is cast iron and not ductile further prevents it from shrinking; therefore the metal cracks open.

If you could remove the rivet each side of the break and by means of a wedge or screw jack force the break open about a quarter of an inch and then make the weld, you could undoubtedly succeed. We can see no other way in which this weld can be made in place but perhaps some of our readers may be able to help.—Editor.

### FIRE DOOR RING

Editor: Can you tell me how to weld a ring around a fire door, broken through a rivet hole? The ring is about ½ x 2 in.—M. Learmont.

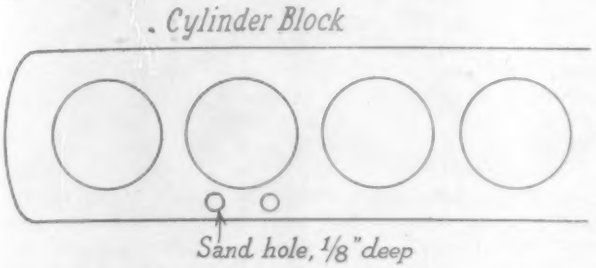
Answer: Remove the rivets on each end of crack, and bevel the crack to a 45 degree angle. Then weld the broken edges with a pure ⅛-in. Norway iron welding rod. After the weld has cooled, all of the rivets should be replaced.—Editor.

### Sand Hole.

Editor:

Some few days ago we took the head off a block motor and found a sand hole about ⅛-in. deep in the valve seat of the third cylinder.

We notified the owner, and he in turn notified the factory, it being a new car. The factory sent an expert who wanted us to weld this hole with the engine in position. We did not agree with him as to the advisability of this, and therefore blocked it.




Do you think it could have been possible to do this job without cracking the block?

Your kind attention to the above will be greatly appreciated. G. Gluckler.

Answer:

Attempting to make a weld of this character in position and without preheating we believe would have been wholly impossible and the block would in our opinion have unquestionably cracked if you had attempted it.—Editor.

---

### Welding Rods.

Editor:

I notice the beginning of what promises to be an interesting series of articles, by M. Keith Dunham. He speaks of it being very important that the right kind of welding rod be used. Now I have heard this statement very often, but no one informs us as to how we are going to tell when we have the right rod. All authors seem to deal in generalities in this respect. Geo. P. Risser.

Editor's Comment:

We believe there is a great deal of truth in Mr. Risser's complaint. We expect to publish some information on the subject of welding rods in the near future.

---

Editor:

Noticing many articles in your valued paper relative to the merits and workmanship of welders, I would suggest that while it is impossible for welders situated long distances from Chicago to go before a board of examiners, that you ought to get a comprehensive idea of their abilities by having a committee made up of yourself, Dunham, Melcher, Kopferschmidt, Diehl and a few more of the BIG BOYS frame a set of questions. These could be made stiff enough and cover the ground so thoroughly that the "Board" (no reflections on their noble domes), could form some idea as to a welders technic. There could be a time limit placed—that is from the time questions are sent until they are answered and returned. Those who are possessed of knowledge and experience sufficient to answer a reasonable amount of questions could be rewarded with a diploma or certificate of proficiency, which could be suitably framed and hung in the "office," to be pointed to when some skeptical prospective purchaser of the learned welders workmanship remarks, "where did you learn to braze?" This diploma would also be a receipt for the $2.00 or whatever is necessary for entrance fees. Of course, the BIG BOYS would gladly contribute their time gratis.

One—Who will be the first to take the "exams".

Editor's Comment:

Announcement of the plan decided upon by The Welding Engineer has been delayed from time to time, because of our inability to frame a suitable or satisfactory examination, and to solve the problem of location of examining boards. This announcement will be made in the near future.—Editor.

---

### Amount of Expansion.

Editor:

We have read with interest the letters in your December and January issues from W. B. Manning and F. C. Sanborn in reference to welding a gear wheel, also from Nels Johnson in reference to repairing a locomotive drive wheel, and note that all of these gentlemen lay stress on the all important question of expansion, but neither gave any direct idea as to the *amount* of expansion necessary. If the latter expanded that drive wheel ¼-in., as he states, he certainly gave the lathe man a good long job before he got the rim back.

The question of just how much to expand a circle in order to complete a perfect job, with the least amount of work to true it up, has been about the most serious proposition we have had to contend with. From our experience we find that the expansion should be as near the amount of contraction in the added metal as possible. If less there is going to be a crack, or an outward strain, which will soon break the wheel. If more, the wheel will most certainly warp in cooling, or perhaps break the rim. In welding a wheel of about 4 feet in diameter we open the crack about ⅛-in. and keep it so until the weld is made. If in preheating, the crack should open more, say ⅛-in. or ¼-in., and we are unable to hold the expansion down to where we want it, as soon as we have the weld well under way we withdraw the expanding heat at once and let the contraction commence at once and continue until the weld is done, all the time keeping the weld *very hot* all around.

A few weeks ago while this subject of "How Much" was in our minds, a gentleman representing a large manufacturer of welding supplies, and evidently a practical welder, came into our shop. We asked him how much expansion a wheel should have. He replied "all you can get, the more the better." As it happened, the following day a gear wheel came in, about 30 in. in diameter, with an inch face, two spokes and the rim broken. We welded the rim first, then expanded the rim until the cracks in the spokes were a full ¼ open, and when we got through with the job we had an excentric that any machinest would have been proud of, provided he wanted an excentric. As it happened the man we did the work for did not want an elliptical wheel and we lost a five spot. A wheel will not contract to its normal size if expanded in excess of the contraction of the added metal.

J. W. Gannon,
Southern Welding Co.

---

### HARD SPOTS IN CAST IRON

Editor: In welding cast iron I have had a good deal of trouble with hard spots which I find in the weld after it is completed, spots so hard that I cannot touch them with a file or chisel—they seem to be as hard as high speed steel. Will you please tell me through your columns how to avoid this?—C. B. Ulen.

Answer: The hard spots may occur through lack of fusion, by an improper welding rod, bringing the cone of the flame into direct contact with the metal, by foreign matter in the line of welding, or by getting some of the old material which was previously hard into the weld.

Foreign material, particularly sand, which may be present on the welding rod or in the casting will cause a hard spot which is like glass and in fact is glass.—Editor.

### SEVENTY-YEAR-OLD WELDER.

It has been said that young men are in demand, because of their "pep" and progressiveness, but it would seem that we have some progressive members of the welding trade who might be termed well along in years. The following is taken from a letter received from one of them:

"I have had years of experience in brazing and welding and don't know it all yet, but as the years go by I get on to new kinks. I mean new to me. I find one very valuable thing to know is the use of carbon pencils or sticks for filling in holes, which need to be protected from the flame. If you are not able to get them from an electrician you can find them in old dry cells, which you can work down to any size or shape. Another good thing is stove clay, which is prepared to reline fire pots. This makes a fine thing to protect light parts or castings which are about to be welded. Don't think you can jump in and weld castings without preheating. Never hurry the preheating. Never cool too suddenly. You must study expansion and contraction, or meet with many failures. Many times it is a good stunt to just hitch broken parts together a little before welding, as some things are in such shape it is difficult to get the parts together as they belong after they are preheated. Fire bricks are indispensible in doing this work, as you can use them in many ways. As for blocking up your parts into place previous to applying the flame, I preheat many castings on the forge, using charcoal for fuel, and if I can't get the charcoal I cut dry hard wood into small blocks, which answers nearly as well as the coal. In some cases I use a gasoline torch with two burners. Other times I use Blaugas with a bunsen burner.

Where small clamps are needed to hold work together while being welded or brazed, I simply take a piece of band iron, the required size, and bend it hair-pin shape, turning the ends in a little, and spring them onto the work. I am near 70 years old and love the work, as I am able to accomplish things I could not do before. A. J. Bostwick.

### SCHOOL QUESTION

Editor: I notice Mr. Frank Adams' kick about welding schools.

I am instructor of oxy-acetylene and oxy-hydrogen welding and cutting, with the Rahe Auto Training School, Kansas City, Mo., one of the largest of its kind to my knowledge. My welders are made in from two to four weeks. I supply oil companies, pipe line construction companies, structural steel companies, shops and garages and cannot supply the demand.

If Mr. Adams is "walking the streets" in San Francisco, or any other welder, it is undoubtedly his own fault. If he will communicate with me, I could more than likely place Mr. Adams, understanding that no booze hister or wind-bag is needed.

My welding shop is as follows: Shop 60x12 ft, 43 ft. of welding tables, 22 welding torches, various makes. Two portable equipments, one cutting equipment, also portable. Private office 10x12. Lecture and demonstrating room 30x12. Cross sections and blue prints of all leading makes of torches, cutting and welding, also cross sections and cuts of reducing valves.

Noting Editor's comment on good schools and bad schools, will admit there are plenty of both kinds, but as yet welders in this part of the country still receive fair wages, ranging from $3.50 to $5.00 per day. We have as yet noticed no ill effects of welding schools. W. S. Penn.

### ALUMINUM WELDING

Editor: I notice from time to time, articles on aluminum, that is, preheating, care and welding. As I am in position where I handle a great deal of this kind of work I find aluminum is a great deal easier than cast iron. My method is as follows:

First—Dress crank case or other work, chipping cracks and beveling all broken pieces to 45 degree angles. Do not waste time scrubbing crank case. Wipe reasonably clean, using waste or rags. Line all parts—(one should have a face plate to set work upon). After setting true all broken parts, spot so as to hold in place. Next place crank case over fire.

Natural or illuminating gas makes the nicest fire. If one hasn't this, use charcoal. With gas, set fire brick on edge, one on each end and one in the center. Cover crank case with asbestos paper very lightly, then light fire. Turn on gas very low to start—blaze about one inch high for the first hour. Thirty minutes later increase fire one-half inch. Thirty minutes more increase fire another half-inch. Fifteen minutes later, take a piece of wire solder, test case in heaviest and lightest places. Notice if parts melt solder readily. If so, case is ready for welding. Use a medium size burner, **(also Presto-Lite sheet aluminum flux).** Weld rapidly—handle as cast iron, keeping away from drafts and keep covered. Allow only opening enough in asbestos paper to do your welding.

After finishing welding cover case, reduce fire to about one and one-half inches. Let reheat fifteen to twenty minutes. Remove from fire, place in asbestos and lime box. Cover immediately—let stay until entirely cool. It is not necessary to wash case when cool, as Presto-Lite flux is absolutely pure and does not cause any bad after effects, as corrosion, etc. Do not puddle aluminum, as chemical dissolves zinc-oxide very readily.

Any questions will be gladly answered, relative to the welding of aluminum or handling. W. S. Penn.

### WELDING LARGE PUNCH

Editor: Last week I was called on to make an estimate on a large power punch for a munition factory that had broken at the base. The casting weighed about a thousand pounds, had two cracks at the base, one 24 and the other one about 10 inches in length.

It required a man three days to chip this casting, removing about 30 or 40 pounds of metal, then we built a fire in the yard, using 600 pounds of charcoal and a cord of wood. In a couple of hours our casting was quite ready for welding. It required two welders, working alternately about five hours to complete this job.

Another company welded another punch the same as this one, only they did not dress theirs to speak of, only removing a very small portion of metal around the fracture. On setting up their machine, it only made one revolution, until it gave way. This failure can be laid only at the improper dressing of this particular piece, while ours is in operation in as good shape as it was the day it left the factory, saving the company about $400.00. W. S. Penn.

### PREPARING WORK

Editor: Of all failures in welding, I think the greatest trouble has been in improper dressing or beveling, as all of my own failures were practically from this cause, particularly on crank shafts.

This class of work calls for particular attention in regard to dressing. Do not be afraid to cut away metal, as it can be more easily replaced than it can be removed after welding. A great many times a welder will not remove enough metal, thinking it is too much work or too hot a job to supply a little excess filler rod. He thereby dresses his work to a very sharp angle, leaving only a pocket in which to do his welding.

He has then added grief to his already hot and tiresome job. My own greatest failure in crank shaft welding was from this cause. I attempted to weld a crank shaft, 8½ in.

in diameter, 14 ft. long, weighing several hundred pounds. This particular crank shaft had a flaw at the cheek about 2 in. deep. I tried to avoid cutting out much metal in order to save putting it in. The result was—a pocket formed in which I could not get the proper combustion of my welding flame, therefore could not start metal to flowing at the bottom of the fracture.

After burning up a number of burners, I finally got started, although the metal did not flow freely. After working about four hours, gave up the job for that day, hoping to get a fresh start on the following day. Next day I could not get the shaft hot enough. After giving up and starting on the third day, we cut out all the metal which we had melted in, even making our job worse than it was in the first place, eventually giving up this job to our more noble friend—the Thermit Weld. This failure can be blamed only on improper dressing. Brother welders, take warning from this. Dress all your crank shafts and similar work to as long an angle as possible and avoid a failure as I might have done.

W. S. Penn.

## COST OF CUTTING

Editor: What would be the cost per foot of cutting with oxy-acetylene a piece of steel 3 in. thick? This steel is about 40 point carbon.—M. Learmont.

Answer: There are quite a number of factors governing the cost of cutting, including purity of oxygen, perfectness of the cutting torch, cleanliness of the metal, pressure used, and yourself, and the latter probably is at least as important as any of the other factors.

Speaking in a general way it might be said that cutting by hand this thickness of metal will use about 10 feet of oxygen and one foot of acetylene for each lineal foot, and that you will cut approximately four inches a minute.—Editor.

## WELDING CAST RING IN PLACE

Editor: How would you weld a cast ring in the fire door of a traction engine? We tried it two or three times, but it always cracks again.—Nesshoefer Bros.

Answer: This matter is rather difficult to understand without a sketch, but evidently you are attempting to weld the ring "in situ," that is without taking the ring off the boiler. As this is riveted to the plate there is probably no chance for contraction to take place naturally and the ring cracks in cooling. If you can spring the break open slightly by means of a screw jack, make the weld and then slowly release the screw jack, you will probably be able to effect the weld without fracture. If you can easily take the ring off the plate, however, and treat it as you would any casting by preheating you will have no trouble.

Whenever you have occasion to ask for information of this character, make a rough pencil sketch of the job and try to show us what you are up against, telling us what you already have done and how you went about it.—Editor.

### Gear Wheel.

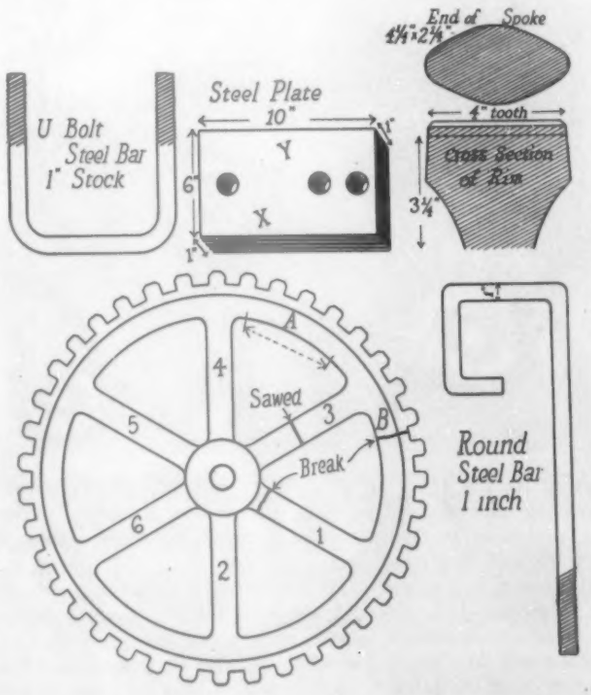
Editor:

This gear wheel had the rim and one spoke broken and the rim was thrown out of true about $\frac{7}{16}$-in. between A and break in rim and caused a great strain on spoke No. 3. I sawed about $\frac{1}{8}$-in. out of spoke No. 3 and chiseled out the spoke from one side only. I chiseled the rim from the inside as I did not want to fill the teeth and have machine work done. I do not know how many degrees I chiseled out as I never look. I always cut out enough to get my torch tip at the bottom with some space to spare as I do not believe in burning tip or getting it too hot as I think oxide from the brass will hurt a weld.

I then made a U bolt from 1-in. stock, cut a thread on each end and put a nut on each end. Then I made a steel rod with a hook on one end and threaded the other end and put on a nut. I made a steel plate 1 x 10 x 6 and drilled three holes in it, put it in the fire and twisted it just above the two holes, x and y.

I hooked the hook end of the rod around gear at B and put the plate on outside of gear just below No. 2 spoke as near as I could. I put U bolt around gear from inside and bolted it fast to plate, then run rod through top hole in plate and set up on nut on rod with a good strain.

I built a firebox around the whole gear but only put a fire at A. As A got hot and expanded I screwed up on nut on rod until it was about $\frac{1}{8}$-in. from true at break at B. I then welded spoke No. 3 as it was tight together. I




let wheel lay two or three hours to let spoke No. 3 come to the rest of the wheel and took off my clamp and found I still lacked $\frac{1}{8}$-in. from being even at break in rim at B in this manner————. I put a fire around spokes No. 5 and 1. When they began to get hot the rim was even at break but lacked about $\frac{1}{16}$-in. of coming together. I welded spoke No. 1 and found the rim still lacked about $\frac{1}{16}$-in. of being straight or even with the end towards spoke No. 3, so I covered it up again. In a short while I took another look and found the rim only about $\frac{1}{8}$-in. out. I then uncovered the hub and let it cool so as to pull the rim back in place. Then I started a fire all the way from spoke 4 to spoke 2, with the most fire at break in rim. Before it was anywhere near red the break was pushed together and I welded the rim on one side as far as I could, turned the gear over and welded the balance. When done welding I put about 8 or 10 quarts of charcoal around each spoke and rim Nos. 4, 5, 6 and 7, then covered until cold. It has been working every day since and that was about seven months ago. James Austin.

## WELDING LONG SEAMS

Editor: I have read with considerable interest your articles on welding and wish to say they are very good and have profited greatly by following them.

Now we have two large tanks to make and thought that

you might give us some pointers on how to take care of the expansion and contraction. The tanks in question are 15 ft. in diameter, 5 ft. high and of one-quarter-inch material. These are all to be welded together. Not being able to get plates which will be large enough to cover the bottom we are compelled to make the bottom of several plates which makes it necessary to make two welds across the tank.

We realize that expansion and contraction is a great problem in this class of welding. We cannot weld these tanks alto-

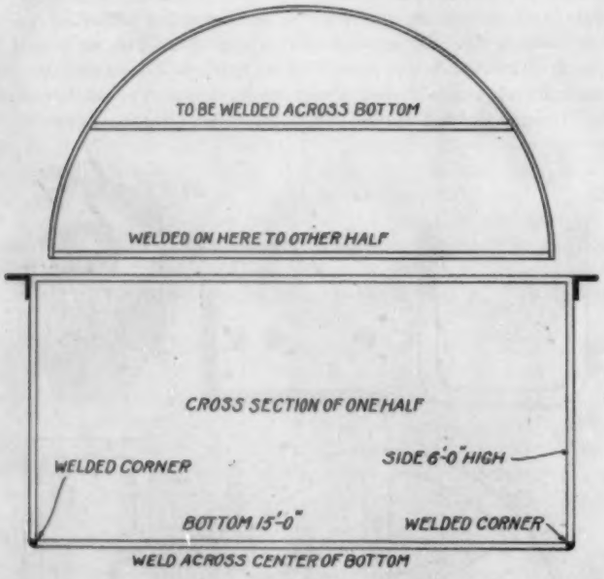



**Fig. 1. Tank to Be Welded.**

gether in the shop on account of not being able to ship them so have decided to make two halves complete. When we get them at the job we will make the weld across the bottom and down each side.

Inclosed is a rough sketch showing where the welds are to be made.—J. L. Brandel, Owosso Boiler Works.

Answer: Inasmuch as you must make these tanks in two halves and then make a weld across the bottom 15 feet long and then up the sides for 5 feet each, you are limited in your method of controlling expansion and contraction.

We hardly see any way you can handle this except to use

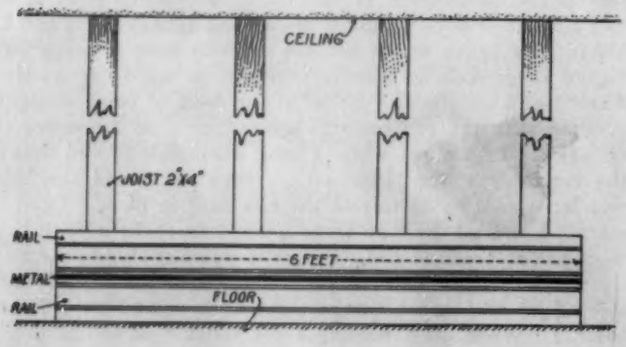



**Fig. 2. Side View of Rails Used as Clamps.**

a drift pin or wedge, moving it along ahead of the weld as required. With this method you are undoubtedly familiar.

In the shop, on a long weld of this character we would advise clamping the sheets. You could do this by getting four car rails and place each sheet between the webs of two rails, allowing the sheet to come through, say a couple of inches from the rail. The upper rail you could hold tight to the sheet by means of joist, which is more clearly outlined in Figures 2 and 3. Using this method it is not necessary to separate the sheets as the heavy metal of the rails acts as an absorber of the heat from the sheet thereby limiting the expansion and preventing the sheets from seriously buckling.

Inasmuch as this long weld must be executed outside the

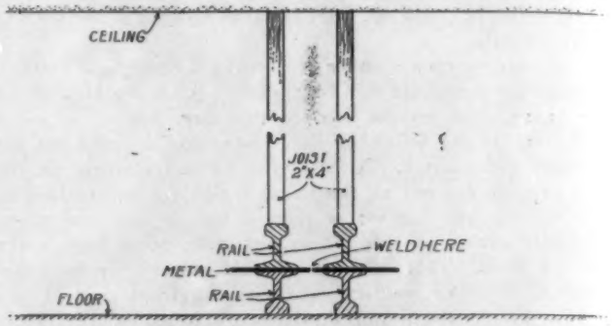



**Fig. 3. End View of Rails Used as Clamps.**

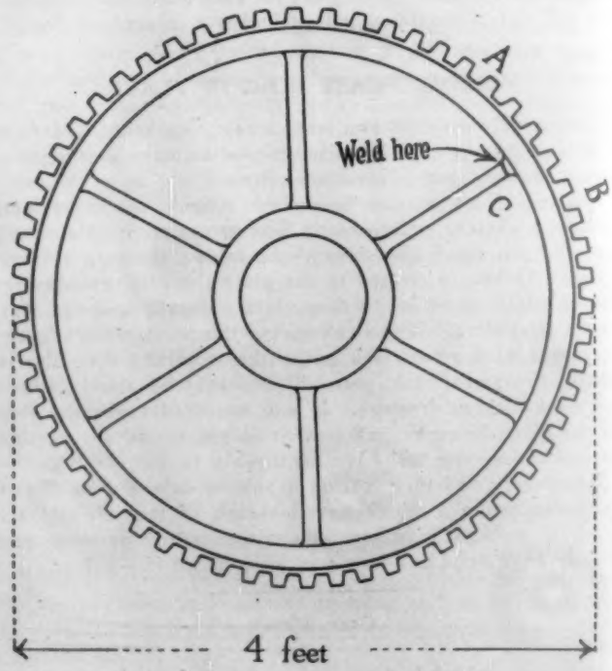
shop and with the 5-foot sheet attached we can see no other way to avoid overlapping than to use the wedge as described but you will have to watch for buckling very carefully and twist the wedge at right angles to the sheet at times to bring one or the other of the sheets in line as may be required.—Editor.

---

### Cold Water Treatment.

Editor:

I welded a cast iron gear wheel and used cold water treatment. Spoke was broken at rim. I beveled both sides and wrapped rim with asbestos at A and B and around spoke at




C, about two inches from crack. I then heated weld, at same time keeping the asbestos wet (until job was finished). I then placed dry asbestos around weld and allowed gear to cool four hours. E. Breckey.

### Cast Iron Rods.

As cast iron becomes harder each time it is melted, it is necessary to use a special casting for a welding rod containing an element—silicin—which tends to soften the weld. If necessary to reweld, grind out old metal.

## GENERAL WELDING REPAIRS IN THE RAILROAD SHOP.

*By George Hills.

Both electric arc and gas welding is profitably employed in the railroad shop. Both systems being applicable to the following: Welding new side sheets in position; building up wasted caulking edges; cracks between stay bolt holes; cracked flue sheets, etc.

While good work is being done by both systems, I cannot refrain from stating frankly that the electric arc system has a very much larger scope in the railroad shop than gas and is much more economical generally, although I would recommend the employment of both systems, as very frequently the one fits in better than the other on certain jobs.

Fig. 1. View Inside of Kettle. Bad Portion Cut Out Ready for Inserting Patch.

For building up wasted caulking edges, welding cracks between stay bolt holes, welding flues in back sheet, in fact for all fire box work, with the possible exception of welding new side sheets in position, I advocate electric. For all

Fig. 2. View Outside of Kettle, Showing Patch Completed.

cutting purposes and welding of light gauge metals, I recommend oxy-acetylene.

For welding broken engine frames, mud rings, engine wheel spokes, etc., and for building up worn parts in heavy sections, the electric system is much more rapid than oxy-acetylene and much more economical.

### Welding Flues to Sheet. (Electric arc.)

This is rapidly developing into common practice. Flues welded to the sheet will usually go the three year limit without necessity of renewal, and with few and rare leakages. Heretofore, especially in bad water districts, flues have to be replaced frequently, due to wastage at the beading through frequent caulking and corrosion.

Fifteen to twenty-five flues may be welded to the sheet per hour per man, depending upon the skill of the operator.

Expand prosser and bead flues in the usual way and weld around the bead. Use ⅛-inch welding rod or wire, about 100 amperes, 60 volts. This current and size wire will give the best results.

### Cracks Between Stay Bolt Holes.

This is a common repair. I have seen as many as thirty cracks in a fire box cut away and welded up with new material. Cut away crack by means of pneumatic chipper, leave an opening of at least ¼ inch back of sheet, weld from bottom upwards, using from 130 to 160 amperes, 60 volts. Lap the new material over the edge of the cutaway

Fig. 3. View Showing Patch Inserted Ready for Welding; Showing Also Metallic Electrode Holder—Hill's Patent.

crack onto the sheet for at least ½ inch each side, build up re-inforcing metal at least ¼ inch in center of weld.

To insure freedom from any possible porosity, weld should be thoroughly gone over with a bobbing tool after completion.

### Building Up Wasted Caulking Edges.

At the lap of seam where the side sheet is riveted to the crown sheet considerable corrosion takes place, eating away the caulking edges of the plate down to the upper row of rivets; heretofore it was necessary to replace the side sheet

Fig. 4. View Showing Patch Being Welded. Note the Arc.

with a new one. The caulking edges may now be built up quickly and economically. Use about 150 amperes, 60 to 65 volts.

### Broken Engine Frames and Mud Rings.

Few, if any, of the railroads have adopted the carbon or graphite electrode system of electric arc welding for repairing broken engine frames and mud rings. Yet the method is decidedly more economical and rapid. Unfor-

tunately this method can be applied only to fractures in the horizontal section. If broken in the leg or pedestal metallic electrode must be used.

Eight hours is the average time for one man to weld a 4x5-inch section, including reinforcing, using metallic elec-

Fig. 5. View Showing Patch Almost Completed. Mr. Hills Holding Electrode.

trode 150,200 amperes, 60-70 volts, or about three and a half hours for two men, both working on the cut-away fracture at the same time, on opposite sides of the frame. (See Cut No. 1.)

The average cost of welding an engine frame, as above, not including any stripping or preparatory work, or shop over-head, is $6.00, while with carbon or graphite electrode the cost would be approximately $4.00, and would occupy but three hours, one man. Figures are based on current

Fig. 6. View Inside of Kettle Showing Welded Patch and Built-up Corroded Portions.

being produced at $0.02 per K.W. hour, and labor at $0.04 per hour in each case.

Approximately 500 amperes at 70 volts should be used with slight changes to suit the conditions at different periods during the welding, the operator using his judgment in that connection. Much more skill is required in carbon or graphite electrode welding than metallic electrode system.

"V" out frame, as shown on figure No. 2. This may be done by burning away the metal by means of the carbon electrode, oxy-acetylene or other suitable method. Care should be taken to leave sufficient opening at the bottom of "V" so as to insure welding entirely through. Do not have the plate "A" shown in figure "2" flush, but dish about ¼ inch below the opening, as further assurance of welding entirely through. The first layer may be welded clear across

Fig. 7. View Outside Kettle, Showing Welded Patch.

the frame or possibly, after practice, the second layer likewise; each layer being from ⅛ inch to ¼ inch deep. The succeeding layers, however, should be made in two heats, each extending half way across the section.

The most important thing to be watched is the slag. It is of vital importance that slag be run off the bath in process of welding. The bath or weld should be kept thoroughly hot and what slag cannot be run or swept off the pure metal will remain at the top so that it may easily be removed when solidified after completing the layer, and before adding

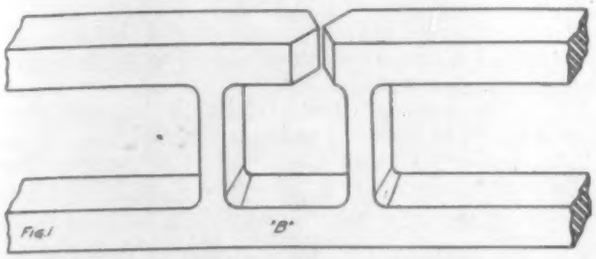
Fig. 8. View Showing Bundle of Armco (American Ingot) Iron Welding Rods, and the Type of Mask Used by the Welder.

new metal. Should the bath not be kept thoroughly hot and liquid and otherwise be muddy and thick, it would indicate too large a bath or patch is being attempted, or there is insufficient current, or both. This would result in a poor weld, as slag would naturally gather at the sides of the weld and adhere to the cold edges, forming a thin partition that would readily break away in service.

Hammer the weld frequently during the operation. This procedure makes a closer grain as well as having a tendency to remove gases which are very detrimental. The hammer-

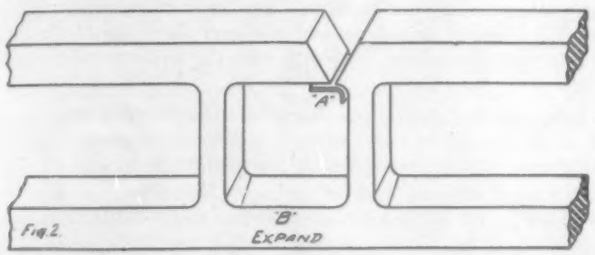
ing should be done when the metal is in a plastic state, but little or no hammering should be done after the metal reaches a dark, cherry red.

It is always good practice to reheat the weld thoroughly to an even orange color by means of an oil or gas burner,




METHOD OF PREPARING FRAME FOR WELDING USING METALLIC ELECTRODE. EXPANDING AT "B" RECOMMENDED.

or even charcoal or coke fire after completion, which will distribute local strains. In case this is done, keep the impeding lower member expanded until removal of heat from the welded member.




NOTE.—The lower, or the member impeding shrinkage of the welded part should be preheated and kept hot as above described. See "B," figure "2."

*With The American Rolling Mill Company.

## REFRIGERATING ENGINEER CONDEMNS WELDING

(Continued from page 23)

is the reason why two of the largest Boiler Insurance Companies in the country object to betting on the autogenous weld in tension, which they do by refusing to insure pressure vessels of this character; they will take a reasonable risk on other things, as that is their business.

Why do practically all of the Boiler Boards, Departments of Safety, etc., including the A. S. M. E. Code Committee, refuse to accept this type of joint, why the Pennsylvania Railroad on its locomotive boilers? Surely the men who control these matters are neither lawyers nor farmers "who doesn't know steel from cast iron," nor yet "engineers" who have "failed to grasp the elemental principles."

I now wish to show you why engineers who have made a study of this class of welding hesitate to accept it for pressure vessels, and my quotations will come principally from Mr. Dunham's "Welding and Cutting" and entirely from articles in your January issue, and these are assumably by experts.

I find it very hard, in reading this article, to resist the impression that Mr. Dunham is more familiar with the principles of practical welding than he is with the details of Molecular Physics, which are involved in the stresses set up in the metal of pressure vessels in practical operation.

Quoting Mr. Dunham: "We must in most cases, secure practically the same characteristics in the weld as has the metal adjoining; yet we are bringing to a melting heat that particular section we are bonding and as the case may be, oxidize, decarbonize or carbonize, produce blow holes, destroy certain alloys and, last, set up a strain which results in the distortion of the article or its breakage—unless we have a general understanding of these conditions."

"To thoroughly understand them and be in a position to overcome them in all cases, not only would it be necessary to be an expert welder, but as well a chemist and a metallurgist. Yet, if we are without this general understanding, *good welding is hopeless.*"

"While there is nothing new therein and it is well known that the power of expansion cannot be overcome, we believe that it is the lack of recognition of this law which is responsible for nearly all the failures of acetylene welding on salvage work and in many cases of construction as well."

"No hard and fast rule can be given as to which method is applicable; we must be governed entirely by conditions as they present themselves but it may be well to repeat that until the operator grasps the importance of expansion and contraction and understands in a general way what it is, he cannot understand the details of guarding against failures which are illustrated in following chapters."

"We must bear these points in mind in planning our weld, since we may not always break a section by lack of attention to expansion and contraction—we may distort it, however, if the metal is ductile or *create a strain which may break later.*"

"There is a tendency on the part of even experienced operators to pay no attention to the effects of expansion or contraction—often as they express it 'to take a chance and weld it cold.' These same operators too often think that bad luck is responsible for welding failures; whereas a little study and an application of one of the four methods of counteracting expansion or contraction previously outlined, would spell the difference between success and failure."

### "Oxidation"

"If we have learned the adjustment of the welding flames, we find that we can secure several kinds of flames, one of them, and the most dangerous from a welding standpoint, being an oxidizing one—a flame having an excess of oxygen. All metals are susceptible to oxidation—the oxygen combined with the metal and forming an oxide—and this action is interspersed as the metal is heated. Iron rust is one form of iron oxide and since we are all familiar with the weakness of iron which is badly rusted, we may conclude that the incorporation of oxide in a weld is to be avoided whenever possible. We may better be in a position to overcome oxidation by understanding how it may occur."

"Water from the oxygen cylinder or wet acetylene, coming through the welding torch, may be deposited in the weld in the form of water vapors and cause oxidation."

"Oxygen from the air may unite with the molten metal. The hydrogen contained in the acetylene, burning to water vapors, may produce oxides."

"A welding torch, improperly designed, not uniformly mixing the gases, may have an excess of oxygen, without being noticeable to the eye, and this oxygen will unite to form a metal oxide."

"And finally, we have the flame which is carelessly adjusted to give an oxidizing cone, which probably is the most common way of causing oxidation and the avoidance of which depends wholly upon the operator."

"As the case may be, we must be careful in our choice of apparatus, in the manufacture or purchase of the gases, and in the adjustment of our flame to avoid oxidation, but even with all this care exercised, oxidation will take place to some extent and we must depend upon other sources to remove these oxides or to minimize them—by allowing cooling, by the use of properly prepared welding rods and correct fluxes."

"The welder must not be discouraged by a recital of the causes of this troublesome feature—if we understand causes, we

are very likely to exercise care—and the oxidation of metals is one of the very serious problems we have to contend with in the joining of metals by the acetylene flame. The welder may not see this oxidation—the weld may have the appearance of being good—so he should know that if it takes place, the weld is deficient in strength and therefore should take particular care to see that the oxides remaining in the weld are as limited as possible. How to more fully guard against oxidation will be taken up under later subjects."

"As we can take out carbon, so also we can increase it, since the acetylene flame is rich in carbon and carelessness in adjusting the welding flame to a carbonizing cone will increase the carbon content to a point where the steel or iron welded may be extremely brittle."

"Decarbonization, however, like oxidation, can take place easily by a careless adjustment of the welding flame, since a cone of an oxidizing character is so easily obtained unless the operator has learned to guard against it."

"We may become welders of a sort without a knowledge of these difficulties; we can never be good operators until we know something about them and how to overcome them, as they may present themselves, and we must again call attention to the necessity of having each portion of the apparatus correctly designed, the gases pure and intelligent operation essential before we may hope to produce the best results. Anything less than the best should not satisfy us and from any standpoint there is a reward as substantial, as it is self-satisfying, when we have accomplished this."

"Welders of limited experience are very likely not to appreciate the knowledge necessary to properly manufacture a welding rod, yet hard welds in cast iron, steel welds, deficient in strength or porous, copper joints, brittle, and aluminum bonds, contain a large quantity of oxide, unless the welding rod is correct. The welder cannot judge the rod by its appearance or wholly by its action under the welding flame and the purchase of the rod, so often made in a careless manner, should be one of careful choice."

"We must not be guided by price quotations in the purchase of welding rods; we are not able to specify cast iron or steel, aluminum or copper rods, but should purchase the welding rods to weld these various metals which are specially prepared by technically trained forces understanding fully the chemical, as well as the mechanical requirements."

"Necessarily, the manufacture of a flux, as a rule, should be carefully carried out and the welders are not equipped to properly prepare or make most fluxes. Inasmuch as they are quite inexpensive in nearly all cases, we should leave their manufacture to those skilled in this line and purchase them with a positive guarantee."

And quoting from the article by J. B. Diehl: "It appears to the writer that one of the greatest injuries done to the welding industry is the fact that there is too much surface welding done."

It is well known among welders that the question of whether the strength of a particular weld be good or poor, may depend upon whether the gas is the first or the last in the cylinder.

Now, I want to quote from the paper of P. A. Armstrong, which was read at a meeting of the Boiler Code Committee of the A. S. M. E. and which is reproduced in this same issue as Mr. Dunham's article, and I wish to say that I was present at the reading of the paper, talked with Mr. Armstrong and I came away with the conviction that it was the best exposition of the subject to which I have listened. He handled all the details in a masterly manner which convinced one that he knew intimately the theory of welding, as well as the practice. There were, however, some very valuable points brought out in the discussion connected with the paper, which you have omitted to publish. I have underlined some of the quotations which seem of vital importance, if true.

He says: "The efficiency of a welded joint must be determined not only by its tensile strength, but also by a consideration of the nature of the changes introduced by welding in the structure of the metal and its most desirable feature—ductility."

"The essential characteristics of a satisfactory fusion weld are:"

"First,—That the metal in the welded joint shall be pure and free from all trace of iron oxide."

"Second,—That the welding process employed shall be such as to reduce to a minimum the thermal disturbance to the structure of the surrounding metal."

Third,—The manual dexterity required in the operation of welding should be eliminated as far as possible."

"The superiority of electric welding over gas or fire welding is due to the extremely localized character of the heat generated by the electric arc, thereby resulting in a smaller area of thermal disturbance."

"The gas welding process has the effect of setting up considerable thermal disturbance in the vicinity of the weld, also it is very difficult to arrange the flame so that it is neutral. In practice, unless very expertly handled, it is generally oxidizing or carbonizing."

*"In oxidizing, the metal in the weld becomes cold-short and the weld generally imperfect—an oxidized layer being present at the junction between the added and original metals."*

*"If carbonizing, the weld will be found very hard, full of small cracks and having a number of gas holes due to the oxygen* in the atmosphere combined with the carbon and forming gas."

"Welding by the means of this process can be very satisfactory if the flame can be made neutral and kept so and the welding metal added to the work in very small quantities."

*"Its practical application in the shops, however, does not lend itself very well to the attainment of this ideal condition and the average weld has patches of iron oxide between the added metal and the original plate."*

"The original metal is overheated and the structure materially changed, resulting in the well known fact—*reduced tensile strength in the vicinity of the weld."*

Again—"The electric carbon arc process has a tendency to heat the area around the weld almost as much as the oxy-acetylene process, and the metal deposited contains magnetic oxide of iron, *practically structureless, being both cold and hot-short*—the fusion between the added metal and the original metal is *distinctly imperfect,* and as everyone is doubtless aware, *many instances have occurred where the entire added portion of the metal has become detached from the weld. Furthermore, a very high grade of skill is required for the proper manipulation of the arc."*

"The bare wire electric arc process overcomes some of these difficulties. The thermal disturbance in the vicinity of the weld is to a very large degree restricted as compared with the two former processes, but the deposited metal is usually oxided *and distinctly cold-short, therefore having almost a complete absence of ductility."*

Then,—"To weld iron and steel satisfactorily the conditions present during manufacture must be duplicated; otherwise a metal of like structure is an impossibility."

"Every steel manufacturer knows to his cost that a melt is quite useless unless it is covered during the entire period of its molten state with a very large body of slag, the duty of this slag being to exclude atmospheric influences and to create certain chemical reactions and conditions in the bath."

Further,—"Much emphasis has been laid upon the elongation of welded sample pieces, but conclusions drawn from tests are generally erroneous as the elongation does not occur in the weld but in the metal outside the weld."

*"No elongation tests of welded joints can be considered unless the measurement for elongation is taken over the actual welded area.* It will be found, generally speaking, that if this system

is adopted, the usual welded joint will show *something less than one-fourth of one per cent.*"

*"The tensile strength of the weld also has nothing at all to do with the usefulness of the weld. It is a well known metallurgical fact that steel containing high percentage magnetic oxide or iron, that has been overheated and burnt, will actually give a higher tensile load than steel, of the same carbon content, which is commercially free from oxide and has not been spoiled by any excessive heat-treatment; but the ductility of these metals is entirely different. The first being cold-short and having a decided absence of ductility, the latter, although having a lower tensile strength, has a very high ductility."*

Now, it would seem to me that the foregoing quotations from presumed welding experts, constitutes about as severe an arraignment as could be desired by the most prejudiced opponent of welding, and, in conclusion, I wish to make it clear that as the mechanical head of a refrigerating company using possibly some of the largest welded pressure vessels in service, both oxy-acetylene and otherwise, and as an engineer being financially and professionally interested in a manufacturing concern doing a large amount of successful oxy-acetylene, as well as forge welding, I am opposed to the autogenous welding of pressure vessels, and this mind you, is neither because of my ignorance, nor my prejudices as an engineer, but because of my intimate knowledge of, and contact with the work in the shop and in service for the past fifteen years, and practically since its infancy in this country.

Notwithstanding this experience, I am not hermetically opposed to the autogenous weld, my opposition being based upon the uncertainty shown by results, as well as by the testimony of expert welders, some of which is plainly indicated by perusal of your January issue, and this uncertainty I am convinced is in a large measure due to loose methods, and the absence of adequate restriction and supervision. It is now possible for anyone with the price, to go out, buy a torch and start a welding shop without let or hindrance.

However, my opposition is based principally upon the knowledge that there is at present in use no reasonably positive method of demonstrating the quality of a particular joint *"after the fact" and without destruction. A welded joint may resist a pressure of 500 lbs. per, today, and fail at 100 lbs. per, a month from now,* indicating, of course, progressive fatigue. Find a reliable method of supervision and testing and the opposition to welding will melt away like high priced coal in a furnace under forced draft.

There seems to be no doubt in the minds of those who have studied the subject carefully, that the welded joint can be made as strong, or stronger, in so much as tensility is a factor, than the sheet, or plate welded, but it is a known fact that with the present methods this is bound to be accompanied by a rigidity of the metal of the joint, which while it protects itself, concentrates the fibre stresses in the sheet just outside the joint and on a line parallel to it.

This concentration of fibre stress is always attended with more or less danger, and when sufficiently pronounced is sure to result in fatigue and ultimate failure in pressure vessels in service, from the fact that fibre stresses are an important factor in these vessels due to the constant breathing which is caused by changes, either of pressure or temperature, or both.

Finally, it would not surprise me to learn that the day is not far distant when the riveted joint will be looked upon as crude and clumsy, not to say brutal, from an engineering standpoint, and the welded joint not only safe, but correct. This will come, however, in my opinion, not by shooting ideas from a commercial standpoint, into ignorant "engineers" or an intelligent public, with a machine gun using "high explosive," but by co-operation and education with a concerted effort to attain the perfection in this line which has been reached in others in the mechanical field.

69 Eastene Ave., Boston. Frank L. Fairbanks.

## WELDING AND SOLDERING ON SUBMARINES

By William Herron

The author relates a case where, through lack of allowance for welding, the process of soldering was called into use, and explains the method in which he handled the work. From time to time we have a job of soldering which can be quickly accomplished, if we understand the way in which to go about the work. The article points out the essential requirements for strong soldering. Photographs are omitted, as the camera is never allowed to show the construction of navy vessels.—Editor.

---

Many a good welder who considers himself quite efficient at welding, stumbles when he is called upon to use a lighter method for joining and making water-tight a job which cannot be welded. There have been a great many instances where the writer has been forced to resort to soldering, after numerous attempts were made to use the advantages offered by the oxy-acetylene process.

Many have the idea that the oxy-acetylene method will do everything and anything, it certainly will do everything and anything in its line, but, there are cases such as the one which I will describe where we can use to better advantage a slightly different method. When we plan and prepare our work in manufacturing for the use of welding we always find it the ideal way of doing the work, but in this particular case the work was not designed for the welding process, and after the frames were assembled it was decided upon to weld the joints.

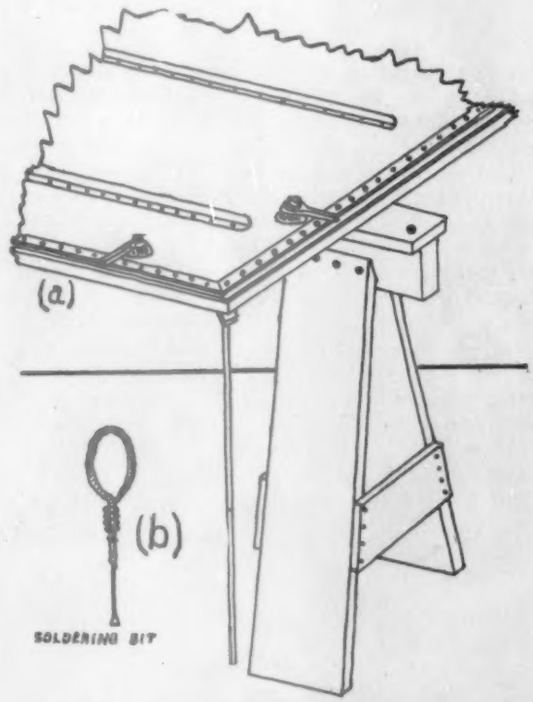



Fig. 2. Method of Supporting Cover for Soldering.

It would not be proper to explain the disastrous results obtained in trying to make the joints by welding and brazing, so we will explain the method used in carrying out the soldering.

The work I speak of are the decks in the battery compartments of Uncle Sam's submarines. A submarine boat is divided into several compartments, generally seven or eight, according to the size and design of the submersible. Two of these compartments are what are called the battery com-

partments, that is, they hold the storage batteries which are used for storing power to run the motors which propel the vessel when she is running submerged. There is the navigation department amidships and to each side of this compartment we have the battery chambers. Fig. 1. will clearly show the location of these, as well as the cross section of a submarine.

The battery compartment is divided in two, horizontally.

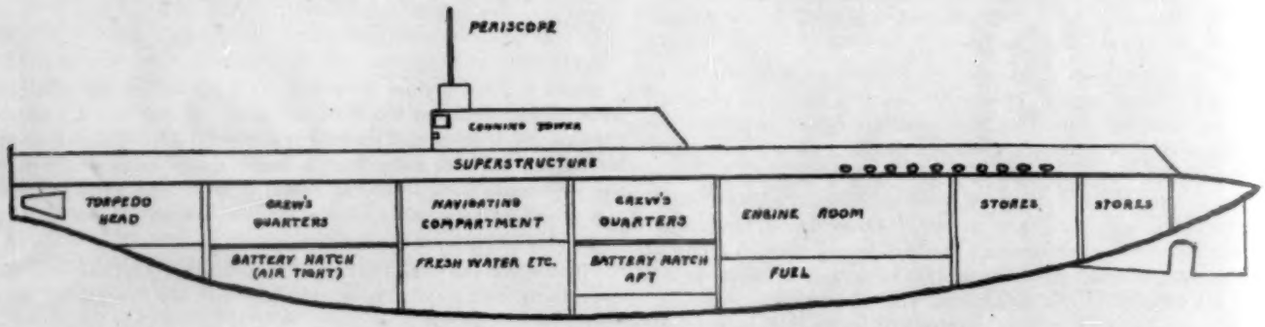



**Fig. 1. Latest Type of U. S. Submarine Showing Location of Compartments.**

The separating partition is called the deck or floor. Below the deck the storage batteries are kept in lead lined vats, and above the deck the crew of the submarine make their living quarters. This deck must be so constructed that it will be absolutely water tight and air tight. The reason for this being that the batteries below the deck give off an asphyxiating gas when they are discharging, and while this gas is drawn from the compartment by suction, it is also absolutely necessary that there be no other escapement of the gas to the upper half of the compartment which constitutes the living apartment of the crew.

This deck is composed of doors 6x3½ ft. called battery hatch covers, usually six or eight in number. They fit on brass frames and are held tight by eight locks on every cover. The doors are composed of a steel sheet ⅛ in. thick bordered with a brass channel frame which is riveted to the sheet. Fig. 2A.

The four corners are mitered as in Fig. 3A and are soldered by hard solder composed of block tin and lead 1:5 which melts at approximately 510° Fah., at this heat the solder does not run but becomes very soft and plastic, of the consistency of red lead, and is very easily handled.

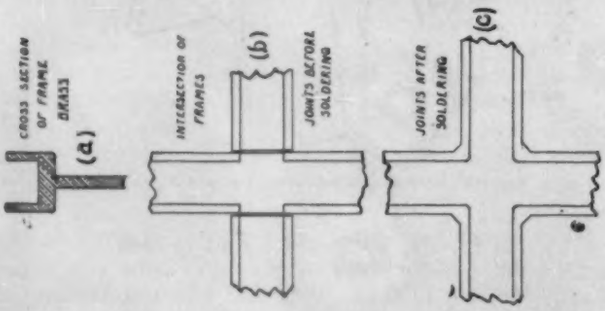



**Fig. 4.**

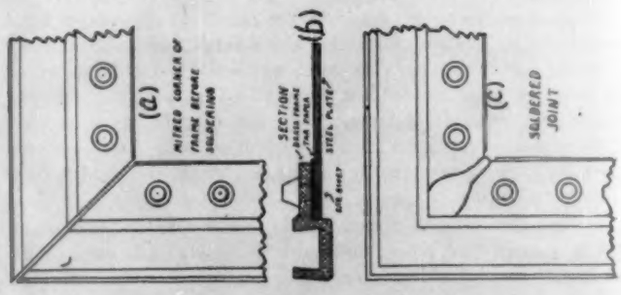



**Fig. 3.**

A heavy rosin flux is used combined with alcohol to make it pasty. A flux quite similar to the ordinary grade used by electrical workers for copper wires, etc.

To describe the method used in carrying out the soldering we advise the reader to study Figs. 3A and B which illustrate the shape and size of the corners. We first of all take a hack saw and run it through the crack which clears away the tar paper gasket between the brass frame and the steel sheet, and also scrapes the steel, cleaning off the layer of oxide, which will allow the solder to cohere to it. We then use nitric acid to remove the oxide from the brass, taking a brush made of cloth (as most all bristle brushes are eaten by the strong acid), and running the acid into the crack and along the surface of both sides about ½ in. each side of it. When the acid turns green, which happens almost immediately, we quench with water which dissolves it and leaves a clean bright surface which allows the solder to run like water beneath the flux. It is a good plan to dry off with a cloth and paint with the flux immediately, as this keeps the metal from becoming oxidized.

With both ends of the miter clean we now apply the heat, which may be that of a gasoline torch, a light welding torch, or a soldering torch (bunson burner type) and when we see that the brass is of the proper heat add more flux and apply the solder which, if the heat is properly manipulated will run very fast over the surface of the brass. Before filling up the crack with solder we tin all the surface which is to be soldered, this enables us to coat the tinning with flux and run the solder on both sides of the joint very easily. As in Fig. 2A we use a piece of steel to prevent the solder from running through.

After the crack has been filled with solder to the thickness of the brass, we now build up the upright cracks of the joint, and in order to accomplish this easily we have a copper bit made of No. 5 copper wire as per Fig. 2B hammered flat at the end. By handling the heat and solder and working it in the crack with the bit we are able to fill it up as though it were putty we were using in place of the solder. The finished corner is shown in Fig. 3C and makes a very strong joint which is absolutely water tight.

To test the strength of such a joint a corner was soldered of the frame alone, without being attached to the steel and proved to be absolutely sound. The corner could be slammed on a steel slab with the entire force of a man and would ring as though it were a casting.

Several attempts were made to braze this joint, but all at-

tempts proved futile, as the excessive heat required to fuse the spelter remained in the frame and on cooling off cracked. This might have been expected as there was only one spot for the heat to stay, the compression of the brass when heated could not be nursed by any manner of slow cooling or preheating.

The frames on which the doors fitted offered quite a problem to solve. The solder used to do the joining on the frames was of a composition which melted about 425° Fah. or lead and tin 2:1. A solder melting at a degree lower than this could not be used owing to its being too thin to build up vertically. A cross section of the joint is shown at Figs. 4A and B.

At first we thought there would be little trouble due to the expansion and contraction of the metal when we used such a low degree of heat in comparison to that of a welding flame. We used the same efficient method of soldering as we did on the doors, but the joint would crack on completing the soldering. We tried several schemes to try to overcome this fault, namely, by having squared copper bars made to fit in the brass channel to absorb the heat, and immediately removed when the joint was soldered. This idea proved unsuccessful and we devised another means of trying to overcome this cracking. We built with fire clay small reservoirs of water in the channel and found great difficulty in getting the brass up to the required heat to melt the solder. This idea also failed and as we had exhausted our stock of ideas we decided on a different plan which finally solved the problem.

We used in this case a very low melting degree solder, so that we could keep as much of the heat from the joint as possible. This solder was composed of lead and tin 2:3, melting at 325° Fah. We tinned both ends of the joint as we did with the first method, and then took small strips of brass $\frac{1}{32}$ in. thick and $\frac{1}{4}$ in. wide, tinned them, and inserted them in the joint. We did the same thing with the upright side of the joint. We then heated the joint and fluxed the surface and applied the solder. We were successful in getting the soft solder to run between the cracks of the joint and the filler. We completed the joint by finishing with the use of the soldering bit.

This method proved to be entirely satisfactory and as there was no need of any strength, only that the joints be water tight we were satisfied. Fig. 4C shows the finished joint.

We now are planning an all welded battery compartment deck which will obliterate all the trouble we experienced in the soldered deck.

I shall be able to describe the method we will use in a later issue of the "Welding Engineer."

---

## WILL ELECTRIC WELDING SUPPLANT RIVETING IN FABRICATING STRUCTURAL STEEL?

### Rapid Progress in Practical Application of the Spot Weld Suggests Possible Economy for Joints of Steel Frames

By G. C. Hinckley

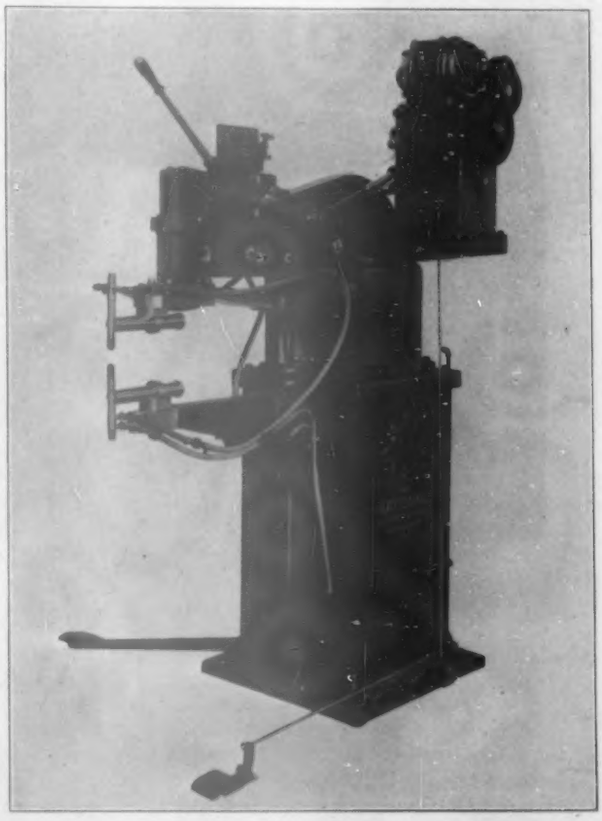
Resident Engineer, Keokuk and Hamilton Bridge, Keokuk, Iowa.

A decade ago the art of welding iron by means of the oxygen-acetylene flame was unknown. Electric welding is of still more recent origin. It is only within the past few years that these methods have emerged from the experimental to their present state of demonstrated practicability and rapidly broadening application in the metal trades. Welding concerns, confining their operations chiefly to repair work, have been successfully established in many of our larger cities. Lap-welded steel pipe and welded boilers and tanks have taken their places on our market in competition with the riveted articles.

### Electric Welding Commercial Success

Electric welding has been demonstrated a commercial success in the manufacture of sheet-metal goods, automobile frames, steel window sash, frames for concrete reinforcement, etc. Its progress is marked particularly by a rapid and pronounced tendency toward the welding of increasingly heavy sections and the perfection of larger welding units, as recently evidenced by the introduction and successful operation of an electric spot welder with a capacity equal to a butt weld of 7 sq. in. sectional area for the field-welding of connection plates across the ends of street-railway rails. There is nothing to indicate that the ultimate limit of capacity has been approximated in this machine, the probability being rather that such a limit will be controlled only by the amount of electricity economically available in any instance.

The remarkable progress in the practical application of these new methods has so far outstripped their literature and



**Manufacturers of Automobile Bodies Are Bending Every Energy to Lower Costs. This Machine, Built by the Nat'l Electric Welder Co., Spot Welds Auto Bodies.**

published data that the subject is marked by a dearth of definite information, resulting in a general lack of knowledge concerning the methods themselves and of appreciation of their possibilities. Lacking such detailed information, and in the absence of specific experiments and tests, it is of course impossible accurately to predict the future of these methods, especially in their possible application to new fields of industry. Nevertheless, when we consider in a broad sense their present status of efficiency and rapid growth, together with the pronounced modern tendency toward the electrification of shop processes and the universal adoption of labor-saving devices, it is logical to assume that, unless unforeseen obstacles are encountered, the electric-welding process promises within the next few years to supplant 90 per cent of the riveting in all our fabricated iron and steel products. In the shop fabrication of structural steel such an innovation

would be nothing short of revolutionary in its character and attended by enormous advantages, some of the more important of which it is now proposed to point out and discuss in a general way.

### A Typical Connection

In the first place, let us assume that the tendency will be so to design welded connections that the welds themselves will be in shear whenever possible, much as is the current practice in riveted joints. Consider a typical connection, a girder web splice, for instance, consisting of the usual pair of splice-plates with double rows of rivets, the splice being subject to the usual tension, compression and shearing stress, and then conceive of the rivets being replaced by a sufficient number of spot welds between the splice plates and the web. The great advantage of the welded splice, both in efficiency and economy, is immediately apparent, inasmuch as it involves no reduction of sectional area in the web or splice plates for rivet holes. It has been repeatedly demonstrated

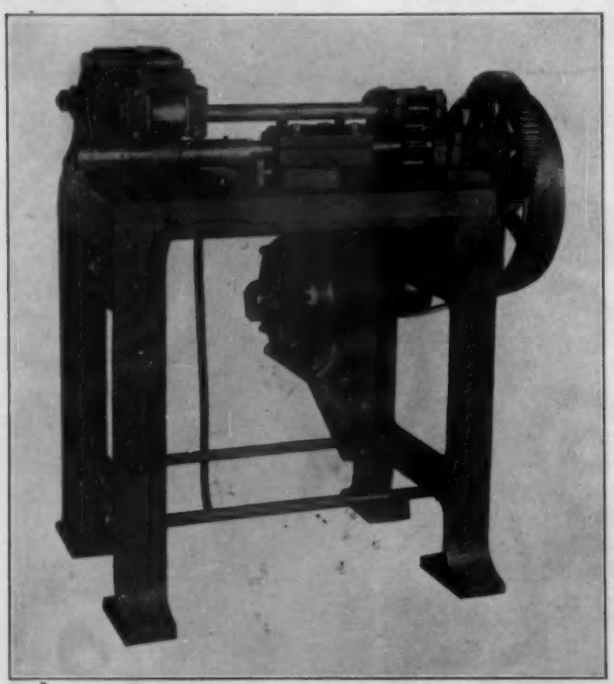


Fig. 2. After Spot Welding Auto Bodies the Seams Are Rolled Down in this Machine.

that the riveted splice cannot exceed about 80 per cent efficiency; the welded connection, on the contrary, may be made 100 per cent efficient, or more, depending on the total area of the spot welds, which may be grouped as closely as desired, or even joined together to produce a single large welded area. While these advantages pertain particularly to tension joints, they are nevertheless applicable in a degree to all points where rivets are now used.

It will thus be seen that the substitution of welding for riveting would result in an ultimate saving of metal in each fabricated member, roughly measured by the difference between the present so-called "gross" and "net" sections, together with a considerable saving in the weight of details, while the opportunity for a better distribution of metal in the design of sections would doubtless result in additional economy. Eventually certain modifications in the rolled shapes themselves could be expected to result in very important saving of metal, inasmuch as the elimination of rivets would permit a more efficient distribution of metal in a great many shapes, in whose design the effective section has heretofore been subjected to the necessity for providing proper riveting facilities.

### Comparing Costs

Anything approaching an accurate comparison of shop costs between welding and riveting is of course impracticable for want of the proper welding data. Yet it is evident that, in the first place, welding would do away with the necessity for punching and reaming rivet holes, with the attendant re-handling of material in the shop, and would doubtless also eliminate fully 75 per cent of the template-making and laying-out work. The cost of manufacturing, heating and driving rivets would be replaced by that of operating the welding machine and also a sandblast for cleaning the surfaces to be welded. In view of these facts it must be conceded that, if the introduction of the welding process should prove feasible, it would result in an immense saving of shop labor, and that the elimination of the punching, reaming and laying-out operations would leave a wide margin to cover any possible increased cost of the welding operation itself over that of

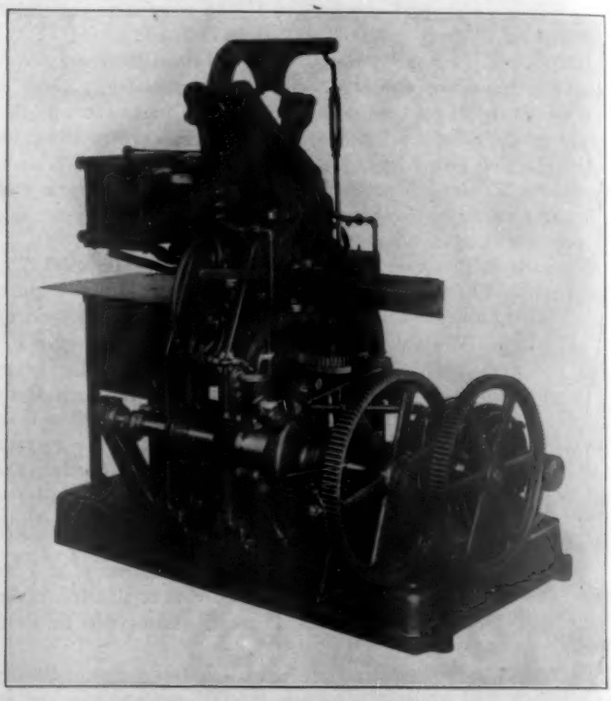


Fig. 3. This Machine was Built to Weld Concrete Forms, a Form Being Shown in the Machine. Forms are Welded Top and bottom. Built by Nat'l Elec. Welder Co.

driving rivets. In the light of results now obtaining in the welding of smaller work, there is reason for the expectation that the total shop cost of fabrication by welding could be brought considerably below that of the present methods.

Comparing, from a mechanical standpoint, the welded and riveted types of connection, it is at once obvious that the advantage lies with the weld, in which the stress coming upon the joint is immediately and simultaneously assumed by each spot weld, the amounts carried by the individual spots depending of course on their relative areas and positions in the group; whereas in the riveted connection the application of stress acts first to overcome friction between the plates consequent upon the initial tension in the rivets, after which the rivets take stress one by one, depending, among other things, on their varying fits in the holes. Under such action, and when subject to any considerable vibration or stress reversal, a riveted joint will loosen more or less in time, resulting in a gradual loss of efficiency and an increasing tendency toward crystallization and deterioration from rust and wear.

It will be contended that the nature of a welded connection involves lack of uniformity in the quality and strength of the

**Quality = *Guaranteed* = Quantity**

***Write US About Your Acetylene Supply***

Commercial Acetylene Welding Co.

ATLANTA, GA.
AURORA, ILL.
BOSTON, MASS.
BOUND BROOK, N. J

80 Broadway, New York City

PEOPLES GAS BUILDING
CHICAGO, ILLINOIS

EAST DEERFIELD, MASS.
TORONTO, ONT.
SAN FRANCISCO, CALIF.
MOBERLY, MO.
W. BERKELEY, CALIF.

welds which must be met by an increased factor of safety. However, the validity of such an objection is subject to question. Inasmuch as the welding process would seem to involve no more uncertainty of uniformity than that of making and rolling the steel itself, if welding were subjected to the same systematic inspection and testing as now obtains in the steel mills, the results would be dependable in a similar degree. There is no apparent reason why the electric-welding process may not be conducted with absolutely uniform results, for once the necessary pressure, amount of current and time of application have been determined for any given thickness of plates these may readily be maintained constant throughout repeated operations.

### Field Connections—Tests Necessary.

While there is nothing in the process to prevent the continued use of the riveted field connections, the same prospect of successful welding obtains in the field as in shop work, the contractor's air-compressor plant and riveters being supplanted by a generator plant (where electric power is not at hand) and a portable electric welder, which for ordinary work

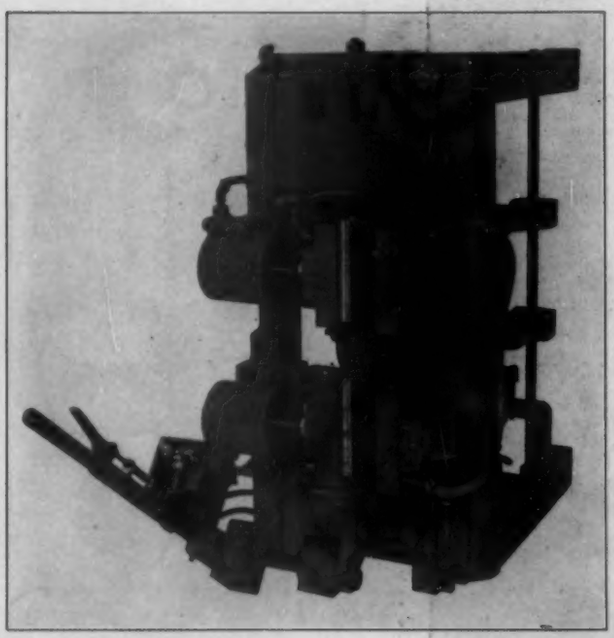


**Fig. 4. Railroad Work is Beginning to Claim the Attention of Manufacturers of Spot Welders. This Machine was Built by the Nat'l Elec. Welder Co., to Spot Weld Locomotive Tubes.**

should be no more cumbersome than the "bull machine" now employed for field-riveting on larger jobs. It may prove advantageous in certain field connections to employ some modification of the oxy-acetylene process.

Comparative tests of welded and riveted connections on identical members are needed to verify the foregoing contentions regarding their relative efficiencies. Investigations should be conducted to determine whether the heating due to the welding process will have any injurious effect upon the steel, with a view particularly toward ascertaining the maximum thickness of metal practicable to be welded under existing conditions and the best method of increasing this thickness. A series of tests using very thin filler plates of pure iron or other substance between the plates to be welded might be productive of interesting and valuable results. Experimental work to furnish approximate data on the costs of welding structural steel is of course imperative. It is suggested that much of the experimental work could be satisfactorily accomplished by universities and technical institutes and by some of the larger structural shops.

### ADAPTABILITY OF SPOT AND BUTT WELDING

The utility of spot and butt welding machines is perhaps not fully realized by the welding trade at large. The new and highly interesting uses to which these machines are being put is enlightning, and no doubt the next few years will witness even further developments.

As most everyone knows, the automobile trade has taken a very prominent part in the development of the application of some process of welding to the manufacture of automobiles and accessories. One department, however, of the manufacture of automobiles which has come in for a great deal of study and experimental work, is the making of automobile bodies. One of the big manufacturers of bodies has recently installed an electric spot welding machine (Fig. 1) which has proven very efficient and satisfactory in operation. Sheets are placed in this machine, edge on, a narrow strip of the same metal being placed under the seam. The seam, and the underlying strip, are held in place by preliminary spot welds. A wire is then "spotted" at the beginning of the seam, as shown, and guided by the operator, a succession of spot welds are made, the wire being mashed down into the seam, the whole becoming a homogeneous weld. As the seams are curved it is necessary for the operator to guide the wire. When the seam is welded it is run through a roller

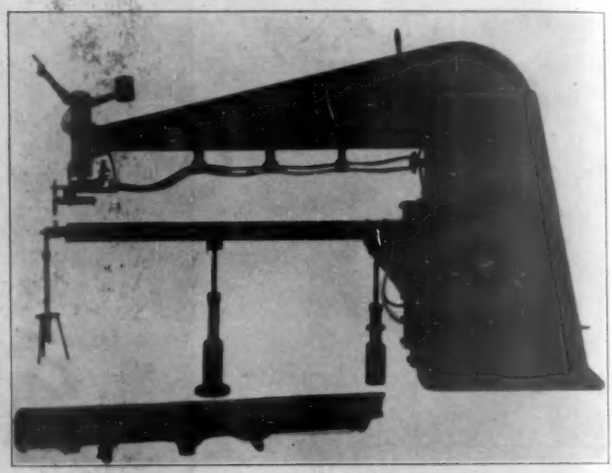


**Fig. 5. The Largest Spot Welder Ever Built. Used for Welding Machine Gun Carriages. Note Carriage at Bottom of Illustration.**

(Fig. 2) which flattens down the seam. It is stated this process is very fast and very satisfactory.

Another new use to which spot welding machines are being put is in the manufacture of concrete forms. The accompanying illustration (Fig. 3) shows a new machine for this purpose. Two welds are made simultaneously with this machine. As shown, the form is fed into the machine on it's side. Welds are made at the flanged base and another at the top of the form.

The welding of locomotive tubes has long been a subject for experimental work. The accompanying illustration (Fig. 4) shows a machine built to spot weld locomotive tubes. It has been in successful operation for some time.

Perhaps the most interesting machine of all is the big spot welder shown in Fig. 5. This, we believe, is the largest spot welder ever built, having an 8 foot throat. In these troublesome times anything which has to do with the manufacture of guns is interesting. This machine is operated on one of the Government plants in connection with the making of our machine guns. One of the gun jackets is shown at the bottom of the illustration. This jacket is slipped over the throat of the spot welder and a succession of spot welds made on the inside and outside of the jacket, for its full lengths.

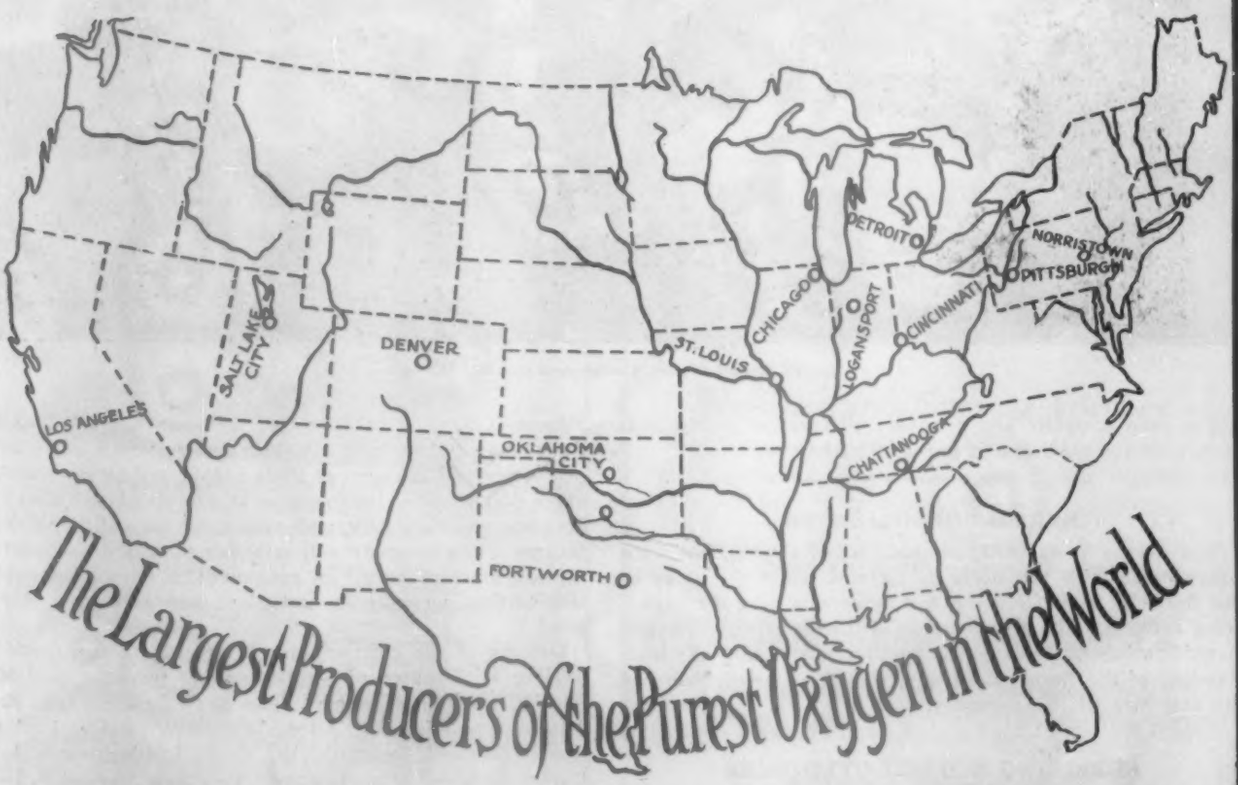
# BURDETT OXYGEN COMPANY

## AND ASSOCIATED COMPANIES

## ELECTROLYTIC OXYGEN and HYDROGEN – 99 1/2 % Pure

Service from the following BURDETT PLANTS

**Los Angeles, Cal.**
**Salt Lake City, Utah**
**Denver, Colorado**
**Oklahoma City, Oklahoma**
**Fort Worth, Texas**
**St. Louis, Mo.**
**Detroit, Michigan**
**Logansport, Ind.**
**Chattanooga, Tenn.**
**Cincinnati, Ohio**
**Pittsburgh, Pa.**
**Norristown, Pa.**
**Chicago, Illinois**




The Largest Producers of the Purest Oxygen in the World

### COMPRESSED GAS MANUFACTURERS DINE

The fourth annual dinner of the Compressed Gas Manufacturers' Association was held at the Manhattan Club, New York, on January 15th. This association includes many welding and cutting interests.

Dr. Hugo Lieber presided and Mr. A. R. Brunker was toastmaster.

At each table may be noted a cylinder of nitrous oxide, more familiarly known as laughing gas. The spirit of the dinner was such that it was not necessary to open any of these cylinders.

### WELDING HOSE

An illustrated circular describing welding hose has been issued by the Davis-Bournonville Co. Hose of every description is shown, from plain high and low pressure to armored and protected hose of various kinds. Welders should remember that "any old hose" won't do for their work. Hose used in connection with welding and cutting should be manufactured for that purpose, as is the hose sold by the D.-B. Co.

### NEW GOGGLE CATALOG

A new catalog devoted exclusively to the subject of welders' goggles and protection glasses has been issued by William C. Adams, 332 Boylston St., Boston, Mass. The catalog is very complete and describes all types of safety goggles, both for welding and for industrial purposes.

### BERMO CONSOLIDATES

The Bermo Welding Apparatus Co., of Omaha, has been consolidated with the Bertschy Garage, under the name of the Bertschy Manufacturing & Engineering Co., the capital being $125,000. The new company will have greatly enlarged manufacturing facilities and resources, which, with the high standing of the Bermo Company, should materially increase the activities of the company.

### REPAIRING SCORED CYLINDERS

This is the subject of a circular issued by New Chemical Process Co., 6 West Ross St., Wilkesbarre, Pa. The new nickel and silver process is followed, no heating being required. The composition used has unusual heat resisting qualities, forces its way into the pores of the iron, amalgamating with it, and becomes a part of the cylinder.

### NATIONAL WELDING COMPANY BUILDS NEW BUILDING

The above company, located at 80-82 Dickerson street, corner of Morris avenue, Newark, has broken ground for an addition to their present building, to be of brick construction and used for their welding work, machine shop and pleasure cars, their present building being principally for trucks and commercial vehicles.

It is remarkable how this business has grown during the past four years under the guiding hand of J. William Phillips, the General Manager, who is always on the job and one of Newark's hustlers.

### THE AIR REDUCTION COMPANY

The Air Reduction Company, 120 Broadway, New York, established about a year ago, has taken over the Superior Oxygen Company of Pittsburgh, including its plants in New York, Illinois, Ohio and Missouri; also the Niagara Oxygen Company of Buffalo and the Searchlight Company of Chicago, manufacturers of acetylene, with branches through the country. It has also installed plants for the manufacture of oxygen and nitrogen at Philadelphia and Detroit, and has other plants under construction at Cleveland and elsewhere. Its plant at Jersey City, under construction, will be the home factory. The company will establish there a department for the manufacture of all its equipment, a school for welding and cutting, an experimental plant and a research department.

Officers of the company are Walter W. Birge, president; Stirling H. Thomas, vice-president and treasurer, and Maurice W. Randall, secretary. The directors are Frederick B. Adams, Frederick W. Allen, Walter W. Birge, Paul Delorme, Edmund Deschars, W. T. P. Hollingsworth, L. F. Loree, Ambrose Monell, Robert C. Pruyn, Samuel F. Pryor and Percy A. Rockefeller.

**Fourth Annual Dinner, Compressed Gas Manufacturers.**

# "Fyber-Weld" Industrial Goggle

**The Welder's Delight**—Made of fibre—an absolute Non-conductor of Heat. Light and durable.

***No. 510. Fitted with Our Famous Essentialite Lenses*** the exact glass for protecting the delicate organism of sight against Ultra-Violet and Infra Red rays.

**Price $3.00 per pair.**

No. 510. Fitted with Smoke Green Lenses.
**Price $2.00 per pair.**

**Fyber Spectacle**

No. 511. Fitted with Smoke Green Lenses. $1.00 per pair.

No. 511. Fitted with "Essentialite" Lenses. $1.50 per pair.

**Manufactured exclusively by**

## THE CHICAGO EYE SHIELD CO.

**Safety Dept. No. 33**

**2300 Warren Ave. Chicago, Illinois**



# No. 2 Harris Welding Outfit

*The largest and most advanced line* of high temperature gas apparatus. *Complete installations* for the most extensive manufacturing, metallurgical, chemical and laboratory operations.

**Welding Apparatus**
**Welding Torches**
Oxy-acetylene
Air-acetylene
Oxy-hydrogen
Oxy-natural
Oxy-carbo-hydrogen
Oxy-artificial
Oxy-coal gas
Air-hydrogen
Air-carbo-hydrogen

**Carbon Burning Outfits**
**Cutting Torches**
**Chemical Furnaces**
**Manifolds**
**Atmospheric Burners**
**Acetylene and Oxygen Generators**
**Pre-heating Apparatus**
**Welding Fluxes**
**Fittings**

**Send for New Catalogue**

## THE HARRIS CALORIFIC CO.

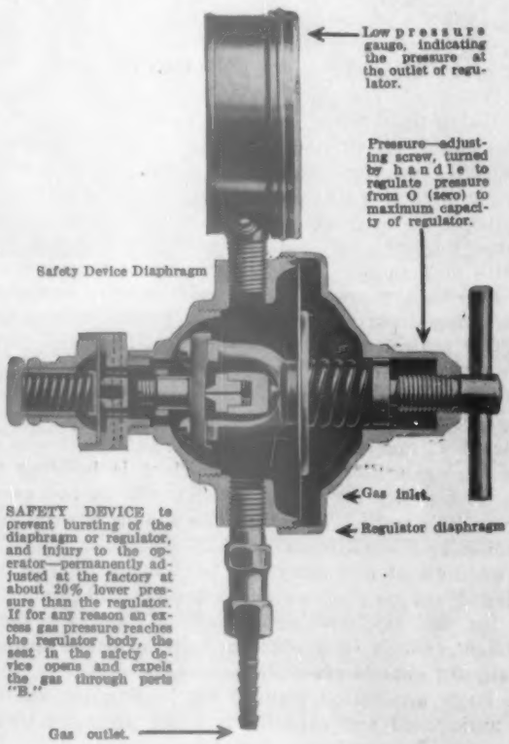
**Established 1905 Cleveland, Ohio, U. S. A. Incorporated 1906**



# Safety First

## B-B-B Diaphragm Safety Device

How often have you heard of a serious accident because of the poor design or weakness of a regulator? Because of the nature of oxy-acetylene welding and cutting, it is of the utmost importance that the apparatus used be properly designed and made to insure the operator.


Low pressure gauge, indicating the pressure at the outlet of regulator.
Pressure—adjusting screw, turned by handle to regulate pressure from O (zero) to maximum capacity of regulator.
Safety Device Diaphragm
Gas inlet.
Regulator diaphragm
SAFETY DEVICE to prevent bursting of the diaphragm or regulator, and injury to the operator—permanently adjusted at the factory at about 20% lower pressure than the regulator. If for any reason an excess gas pressure reaches the regulator body, the seat in the safety device opens and expels the gas through ports "B."
Gas outlet.

## Accidents Are Impossible

The B-B-B Diaphragm safety device takes care of any excess gas pressure—the safety device works like the blow-off on a steam boiler. The pressure never reaches the danger point. B-B-B regulators are strong, durable and reliable.

## Welding and Cutting Torches

B-B-B welding and cutting torches are made with the same care and thought as are B-B-B regulators. They are built to give maximum results with perfect safety.

***Send for Complete Catalog***

## The Bishop-Babcock-Becker Co.

**General Offices and Factories:**

**CLEVELAND : : : : OHIO**

***Branches in the Larger Cities***

### PREHEATING TORCHES

A special bulletin, No. 66 W, has been issued by the Hauck Mfg. Co., 142 Livingston St., Brooklyn, N. Y., relating to oil burning torches for preheating. A copy will be sent on request.

---

A plant for the manufacture of Carbide will be erected by the Bremanger Power Co., at Svelvasdrag Falls, Christiania, Norway.

---

### NEW BURDETT PLANT

The Burdett Oxygen Company will begin operation of its Oklahoma plant, located at the Stock Yards Station, Oklahoma City, on February 15th, and will be in a position to furnish Oxygen to users in that territory. This is the twelfth plant installed by the Burdett Company in the various industrial centers of the country.

---

### STEEL PRODUCTS CO. ENLARGES ALL THREE PLANTS

Following their recent acquisition of The Metals Welding Co., of Cleveland, and The Michigan Electric Welding Co., of Detroit, The Steel Products Co. have entered upon extensive additions to all three plants. The new buildings and equipment will provide for increase of business, naturally resulting from the consolidation and from the fact that the one firm now supplies so large a range of requirements.

At the main plant on Clarkwood Road, Cleveland, the heat treating departments have been greatly enlarged. The system of central control of all furnaces has been perfected to a high degree, making this department the most complete of its kind in the industry.

Two large forge shops or "hot" shop units are just being completed at the same plant.

The Michigan Electric Welding Plant is building to increase its capacity for machine operations on rod assembly and drag link work. They are also adding largely to their warehouse and stock room space.

An addition of one story has been made to The Metals Welding Plant on Perkins avenue, Cleveland, giving more room for the gas welding department, and for the bolt department, which is producing bolts in large quantities, especially for chassis assembling.

The large production planned by leading car makers is being anticipated and capacity is being arranged that will take care of the maximum demand.

---

### NEW WESTINGHOUSE PLANT

Announcement has just been made by the Westinghouse Electric & Mfg. Company that the plot of ground recently purchased at Essington, near Philadelphia, will form a new industrial center for the Westinghouse Electric interests. The site embraces about 500 acres, with a frontage of approximately one mile on the Delaware River. Additional transportation facilities will be afforded by tracks from the Pennsylvania and Philadelphia & Reading Railroads.

This new center will be devoted to the production of large apparatus, the first group of buildings being for power machinery, principally steam turbines, condensers, and reduction gears. The initial development will cost in the neighborhood of $5,000,000 or $6,000,000, occupying about one-fifth of the area of the entire plot. The group will consist of the following buildings: Two large machine shops, an erecting shop for heavy machinery, forge shop, pattern and pattern-storage shop, and power house. Work will begin on these as soon as satisfactory building contracts can be let.

The number of employes to be engaged at the new plant has not as yet been definitely determined but will number several thousand people, and undoubtedly will in the future equal the number employed at East Pittsburgh, representing over 20,000 people.

### WELDING A BIG PRESS

A big job of welding was recently handled in record time by Smith Hamburg Scott Welding Co., Detroit, Mich.

This press arrived in shops Jan. 17th, at 4 o'clock in the afternoon, was set up in 1 hour and 15 minutes. The top being broken clean off just below the bearing. Casting was charcoaled and fired the morning of Jan. 18th, 4 A. M., by the use of city gas and air. The casting was ready for welding at 9 o'clock.

Two men started cutting the V's out, one on each side of the bearing, by putting a tin partition between the two broken members. The V'ing out was completed at 10:35 and the welding started. Here the relief man gave each man 20 minutes' rest; this was repeated three times during the whole job. The welding being finished with two large reinforcements in 7 hours and 40 minutes. One hour was spent in cleaning and smoothing the two welds and putting on the annealing fire.

By welding both sides at one time the casting was kept in perfect shape and was practically as hot at finish of welding as when started. This plan when it can be used is very successful.

The casting cooled down about 10:30 on the morning of Jan. 19th and was returned to the owner two hours later. Weight of casting, 3½ tons; height of casting, 11 ft. 2 in.; 2 welds 11 in. wide and 9 in. deep; 1½ hours cutting, 2 men; 7 hours and 40 minutes welding, 2 men.

Welders—Foreman Geo. Bivens, J. Blanzy and C. Bradley.

One-half inch cast iron supplied by the Superior Oxy-Acetylene Mfg. Co., Hamilton, Ohio.

Cast Iron Flux supplied by the Metals Welding Co., Cleveland, Ohio.

Acetylene supplied by the Prest-O-Lite Co., Detroit, Mich.

Oxygen supplied by the Linde Air Products Co., Detroit, Mich.

Oxweld torches used, No. 15 tip.


# Classified Ads

Help Wanted—25c per line, minimum 4 lines.
Jobs Wanted—4 lines free.
Other Ads—50c per line, minimum 4 lines.
Count 8 words to line. Add 6 words for keyed address.

**WANTED**—Oxy-Acetylene Welder; must understand Auto work. Steady position. State salary expected. GOODIN MOTOR CO., Wichita, Kan.

**WANTED**—First-class welder with several years' experience. Address Sharpsburg Mach. Shp. and Garage, Sharpsburg, Iowa.

**HOW TO REPAIR SCORED CYLINDERS** by the new nickel and silver process, no heating required; same pistons and rings used, experience not necessary; complete outfit $10.00. A big money-making proposition. New Chemical Process Co., 6 West Ross St., Wilkes-Barre, Pa.

**FOR SALE**—Immediate Delivery. Thomson Size 20-A electric welding machine with 30-K. W. Thomson Generator and necessary instruments comprising complete butt welding outfit. Apparatus practically new. Address E. C., Welding Engineer.

**WELDERS WANTED**—About 10 experienced oxy-acetylene welders; permanent position. Apply Meurer Steel Barrel Co., Borden Avenue and Heyward Street, Long Island City, N. Y.

GENERAL WELDING & EQUIPMENT CO.
G.W.&E.C.
107 MASSACHUSETTS AVE. BOSTON, MASS.

WELDING & CUTTING EQUIPMENTS

PASSED BY INSURANCE AUTHORITIES, USED IN NAVY YARDS AND OTHER IMPORTANT CONCERNS

Our Equipments are designed by the well known
CONSULTING ENGINEER, DR. A. KREBS,
They will appeal to the people who know what they ought to have and what they have been unable to find as yet. We have it.

GENERAL WELDING AND EQUIPMENT CO.
107 Mass. Ave. - BOSTON, MASS.

Welding Plants
FOR
All Purposes
$25.00 to $250.00
Liberal Terms If Desired
Address Department C.

Bermo Welding Co.
Omaha, Nebraska, U. S.

DON'T SCRAP ALUMINUM PARTS
USE SO-LUMINUM Trial Bar 50c.
New—Great—Welding Compound for Aluminum—Does away with weak Aluminum Solders—Perfect substitute for Acetylene Welding—One-half time and Cost. Use gasoline torch—No flux—Guaranteed strongest and best soldering and welding compound in the world.
Full instructions furnished with each order.
SO-LUMINUM MFG. & ENGINEERING CO., Inc.
1790 Broadway Dept. E. New York

ALUMINUM SOLDER
Welding and Cutting Equipment, Generators, Fluxes, Welding Rods and Wires, Brass Foundry Products. May we put your name on our mailing list?
The Ideal Bronze Company
CLEVELAND, OHIO

Oxy Acetylene U.S. Welding Apparatus
Cutting and Decarbonizing Apparatus Parts and Supplies
UNITED STATES WELDING CO., Minneapolis, Minn.

Come to Detroit
The Automobile Center and
LEARN BRAZING AND WELDING
33,000 sq. ft. of Additional Floor Space
Get into this new business. Big demand for trained men at big pay. Brazing, Welding, and Cutting Shops make big profits. Work comes easily. Business is easy to learn. Work is extremely interesting. You complete course in a short time. Michigan State Auto School graduates get $4.00 to $5.00 a day to start in the brazing departments of the Auto factories. They are taking practically all our graduates. Shops everywhere write us for men at big pay. School open all year. Enter classes any time, any day. Three classes daily, morning, afternoon, evening. Get one of the good jobs or go in business for yourself.
EARN $25.00 to $75.00 A WEEK
Brazing and Welding is the modern way to repair. You get actual experience handling all kinds of metals. Special instructions in Oxy-Acetylene cutting, as used in wrecking steel structures and heavy machinery.

Sectional View of Brazing and Welding Department
Every student handles the torch—get actual experience and practical training.
Go Into the Business
Big demand for Brazing, Welding and Cutting Shops all over country, as well as demand for trained men. Open a shop for yourself. You repair all kinds of metals for all trades and factories as well as Auto Industry. Farmers, factories of every kind and garages are big buyers of brazing and welding. Write now for catalog and prices of course, or better still, jump on a train and come to Detroit, as others have done. We have no branches. Write or come direct to this school.
MONEY BACK GUARANTEE
We guarantee to teach you Brazing, Welding and Cutting and qualify you to hold a position paying $25 to $75 a week or return your money.
MICHIGAN STATE AUTO SCHOOL
A. G. ZELLER, President
1302 Auto Bldg., 11-19 Selden Ave., DETROIT, MICHIGAN
EMPLOYMENT DEPARTMENT
We maintain an employment department and can supply men to manufacturers who need them, or we can place trained men in good positions.

M. KEITH DUNHAM
Consulting Engineer
50 Church Street, New York City
Specializing in
*Oxy-Acetylene Apparatus and Use*
Improvement of Equipment Accident Prevention
Redesigning of Manufactured Articles to Meet Welding or Cutting Requirements
Lowering of Operating Costs in Welding or Cutting

Superior } *Welding, Cutting and Carbon Removing Equipment*
Everything that the name implies.
Welding — Sheet Metal — Lead Burning, Battery Torches; Cutting Torches; Regulators and Gauges; Cast Iron, Aluminum, TOBIN, Manganese, Vanadium, Norway, Carbon Blocks, Hose, Aluminum Solder, FLUXES; Acetylene Generators.
Write for catalog and monthly price list. Repeat orders tell the tale, we get them every day.
Superior Oxy - Acetylene Machine Co.
1102 East High Street, Hamilton, Ohio

WANTED—Two oxy-acetylene welders who can produce results. General repair work. Steady employment. Manitoba Welding Co., Winnipeg, Manitoba.

Welders Wanted—Instructors and demonstrators for oxy-acetylene welding and cutting apparatus; requirements—general railroad experience, including boiler repairs. Address Railroad, care *The Welding Engineer.*

Wanted—Position in East by experienced welder. Address Nelson Baldwin, 335 Market St., Gloucester City, N. J.

Wanted—One expert and three A-1 welders on all metals in job shop. Both extra large and extra small work. Write Clair W. Kelly, 305 S. Washington Ave., Lansing, Mich.

For Sale—Established Oxy-acetylene Welding Business with all equipment, employing two expert welders, Oxweld Apparatus, exceptional opportunity. Reason for selling, leaving United States, must sell before March 1, 1917. Address J-1.—*Welding Engineer.*

Wanted—Salesman to solicit subscriptions to *The Welding Engineer,* or furnish names of possible readers. Compensation good. Correspondence confidential. Write Mackenzie.

**WELDING PHOTOGRAPHS**

**We make a SPECIALTY of photographing welding jobs**

**Chicago Architectural Photographing Co.**

**140 So. Dearborn Street** **Chicago, Illinois**

**Pure Oxygen and Hydrogen**

**Made by the Electrolytic Process**

From either of our complete plants we make immediate shipments. A full stock of welding equipment is carried. It will pay you to write for prices. Our Service Department is at your service.

**The Logansport Oxygen Company**

**Logansport,** **Indiana**

**Ohio Electrolytic Oxygen Company**

**Cincinnati,** **Ohio**

**Messer**

**Welding and Cutting Apparatus**

**Acetylene Generators--Pressure Regulators**

**MESSER & CO.**

**117-119-121 N. Seventh St., PHILADELPHIA, PA.**

**WANTED:**

**Foreman, Mechanics and Brass Finishers**

with thorough experience in the making of OXYACETYLENE TORCHES, REGULATORS, etc.

Highest wages, permanent positions and rapid advancement for the right men with growing manuacturers. Location in the east. Applicants state age, experience, references and earning ability. Box No. 77, "WELDING ENGINEER."

**WANTED**

The services of a man with experience in the sale of oxy-acetylene welding and cutting apparatus or the sale of compressed gases, to travel the state of Alabama, Georgia and Tennessee.

Applications will be considered confidential.

**Manufacturer**

***% Welding Engineer***

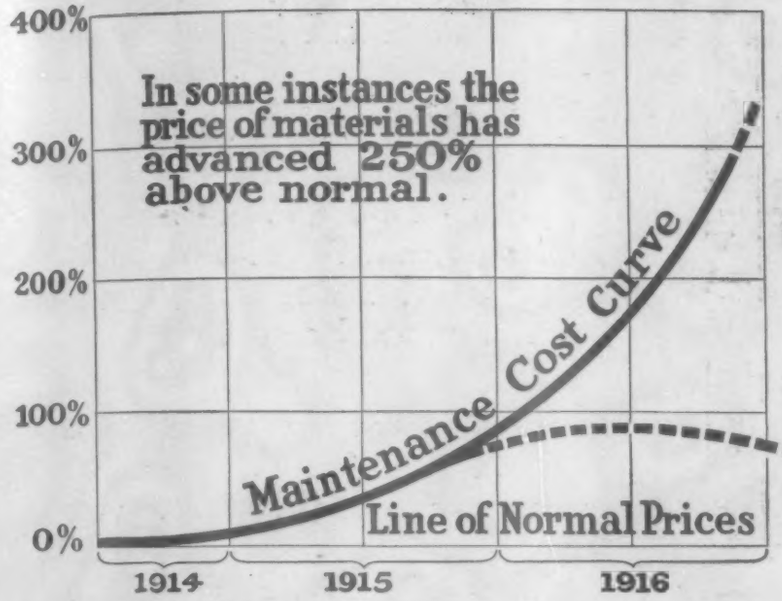
**The Right Kind of Welding Rods**

It is not sufficient to order just plain welding rods. A special training and knowledge is necessary in the manufacture or rods of quality. The ordinary local foundry, could not furnish you rods of B-E quality. Price is the last thing to consider in purchasing welding rods. Every welder dreads a failure. Be fair to yourself—ask your nearest jobber if he can supply B-E welding rods, wires and fluxes. If he can't write us direct.

**BIERMAN-EVERETT FOUNDRY CO.**

**41-61 Glorieux St., IRVINGTON, N. J.**

# Westinghouse Arc Welding Outfits




# Bend the Cost Curve Down!

Westinghouse Arc Welding Outfits had proven indispensible as

## TIME AND MONEY SAVERS

—long before the present period of abnormal prices. Now their value has multiplied.

Repairs can be made quickly and at a very small fraction of the cost of renewals.

Let us give you actual figures on the savings made with the Westinghouse set.

Welding the Westinghouse way is the safest, the quickest, and by far the most economical.

**Westinghouse Electric & Manufacturing Co.**
East Pittsburgh, Pa.

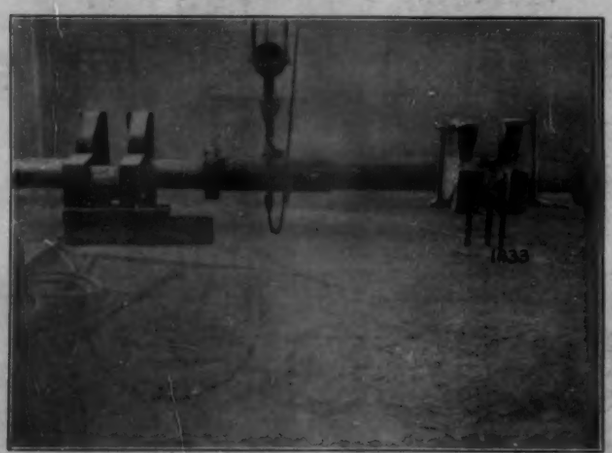
# Westinghouse

W
WESTINGHOUSE ELECTRIC

New neck cast on to large roll made with the aid of Thermit and having the pods cast in at the same time.

Large bevel gear on which two new teeth and crack have been repaired.

Four Thermit welds on locomotive frame on the Missouri Pacific Railroad, made without removing the frame from place.




New crank pin welded in by the Thermit Process.

# We Are Prepared

## To Undertake at a Moment's Notice the Handling of Any Serious Breakdown

Breakage and wear in steel mills and other manufacturing plants has been greater at this time than ever before.

We have been called upon by so many large iron and steel companies recently to make quick repairs to broken rolls and pinions, connecting rods, shears, crank shafts, locomotive frames, and many other sections, the breakage of which often means a serious delay in the operation of the plant, if not a complete shut-down.

Wire or telephone our nearest office and we will proceed at once for arranging the shipment of materials and send an expert to supervise the repair.

We have an eighty-page pamphlet devoted exclusively to this class of work, which is known as pamphlet No. 1779, and tells how the work is executed and how you can do the work yourselves.

## Goldschmidt Thermit Co.

William C. Cuntz, General Manager

Equitable Bldg., 120 Broadway
**New York**

329 Folsom Street, San Francisco
7300 South Chicago Avenue, Chicago
103 Richmond Street, W., Toronto, Ont.